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WE GUARANTEE, that of this issue 10,850 copies were printed; that of those 10,850 copies, 9,869 copies were mailed or delivered by messenger to regular paid subscribers; 800 copies were distributed among members and guests of The Railway Signal Association and at the Coliseum; 131 copies were mailed to advertisers; and 50 copies were set aside for office use.

CONTENTS:

The attendance at both the morning and afternoon sessions of the association yesterday should be a source of much gratification to the officers and to the membership at large. Even though the morning session began at 9 o'clock, there has been no preceding opening session in the history of the association when so many members were in attendance, and at many times throughout the day many men were standing after all chairs were filled. The large attendance and the interest in the discussions forecast that the fourteenth annual convention will surpass all previous records for interest and value of the work done. The registration yesterday was 315, which is the largest for an opening day in the history of the association.

In marked contrast with its presentation last year, the report of Committee 10 on the Uniform System of Signaling, which has been under discussion for so many years, was unanimously adopted without discussion. This is the same report that met with such a favorable reception from the Signal Association last fall, and was referred to letter ballot at the Quebec meeting by unanimous vote, and also without discussion, and was passed by a vote of 574 to 10. The adoption of this report by both associations will now enable it to be referred to the American Railway Association, probably just in time to be taken into consideration in the revision of the standard code which that organization now has under way. The reports from Committee 10 on the other two subjects were offered merely as information. The one dealing with effects of treated ties on track circuits was interesting, the information having been taken from the experience of a large number of roads, all of which seem to have had such varied results that at this time there is not much upon which to base definite conclusions, although the committee did very well in this respect.

The suggestion made by Mr. Loree at the annual dinner of the American Railway Engineering Association one year ago that in view of the large proportion of the expenditures of the maintenance of way department devoted to labor, the association give more attention to the economics of labor, has borne its first fruit this year. Acting upon this suggestion the board of direction assigned this subject to three committees last spring. The first report embodying definite recommendations is that of the Track Committee, which made three recommendations regarding desirable agencies to obtain a better class of section foremen. Before starting upon this work the committee made an outline of the most essential subjects to be considered, this outline including subjects enough for several years' study. Judging from the very general response to the request for information by the sub-committee having the matter in charge and by the interest shown in the convention yesterday, the members and railway executives in general agree upon the importance of this subject. The fact that the cost of labor in the maintenance department is increasing indicates that the situation is becoming worse. It is frequently the case in associations of this kind for a desire to be shown to avoid reference to labor conditions, especially where any recommendations involve the question of an increase in wages. If an increase in wages is essential to the maintenance or increase of efficiency, it is just as much within the province of an association to recommend it as it is to make a recommendation regarding the selection of material. The subject of economics of labor has been neglected so long and is now such a pressing one that the association is to be congratulated for taking it up even at this late date, and it is to be hoped that the committees will be encouraged to go deeply into the subject and make definite recommendations, even though they may perhaps involve increases in wages or rearrangements of forces

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Some of the rules for the organization and guidance of inspectors in the mill, shop and field, presented by the committee on Iron and Steel Structures, seem to be rather a general discussion of the subject of inspection than a series of definite rules for the guidance of an inspector familiar with his work. Many of the qualifications of an inspector outlined in the preamble would be equally desirable in any other line of business. While this information might be valuable to a man unfamiliar with the subject, it is hardly to be expected that such a man will be employed as an inspector without previous mill experience. In one place it is stated that the inspector should "study the operations of the plant and become familiar with the various processes of manufacture." To be qualified as an inspector, a man should have this knowledge of the processes of manufacture before being appointed. Some of the requirements in the rules seem to belong more properly in the specifications furnished to the inspector than in the rules outlined

for his guidance. The minority report calls attention to some of the defects in the present system of inspection which are common knowledge. May not many of these defects be due chiefly to the effects of severe competition? When a railway or other concern lets contracts for the inspection of material upon the basis of competitive bids, the service is pretty sure to deteriorate as the price of the work is reduced. Inspection in many ways is not now as efficient as a few years ago; but the same price is not being paid as in former years. The establishment of a railway inspection bureau by the railways themselves would not necessarily reduce the actual cost of inspection; and if the standard of inspection is to be raised the cost probably will also be increased no matter who does it. The objection that the present inspectors do not gain the advantage of personal contact with the heads of private bureaus is true only to the extent that the inspectors now come in contact with the department head devoting his entire time to one specialty instead of with the general heads.

In commenting upon the amount of study which railway men, and particularly the members of the rail committee, are giving to the rail situation, a prominent student of this subject said a few days ago that nearly all the attention is being given to the manufacture of the rails, which is under the control of the steel makers, and comparatively little organized attention is being paid to the protection of the rails in service, which is under the control of the railways themselves. There appears to be some foundation for this statement. The need for improvement in the manufacture of rails is one of the most pressing affecting railways at the present time. We do not desire to minimize in the least the necessity for the work to get better rails which has been done, or the value of the improvements which have resulted from this work. But, as we have stated before, it does not appear entirely reasonable for the railways to have to provide the funds or the investigators to teach the steel makers how to manufacture their product. Nor is it to be supposed that all the facts brought out in these investigations are new to the manufacturers who have devoted their entire attention to the making of rails for many years. There is no question that the quality of the steel going into the rails leaves much to be desired; but the same is true with regard to the quality of the roadbed and equipment. It is to the defects of the latter, the remedies for which are directly under the control of the railways, that it would seem advisable for the association to devote more attention. It is not commercially practicable to produce rails every one of which will be absolutely perfect, or to maintain the track or equipment in such condition that no broken rails will result. While it is true that almost without exception the rails which give rise to serious wrecks and loss of life and property, are seriously defective, many sound rails were broken last winter because of the unusual climatic conditions and defective equipment and roadbed. Even granting that little danger is due to broken rails of this class, there is some danger, and the financial loss due to the destruction of a large number of rails by a flat wheel is material. It would seem that some concerted study, perhaps by a joint committee of the railway mechanical and engineering associations, should be made of the effects of defective equipment in various degrees of development on the rail under different conditions of roadbed support, temperature, etc. There is also a need of definite information regarding the service which a rail has to withstand in view of the recent statements that the rail is being overloaded. The stresses actually present in the rail, the influences of varying standards of roadbed support, high speeds, heavy wheel loads, low temperatures, etc., are important. In other words, while continuing to devote a large amount of attention to the study of the manufacture of steel rails it would also appear desirable to devote some attention to the improvement of service conditions, the remedies for which lie directly in the hands of railway officers.

STUDYING THE SCIENCE OF ORGANIZATION.

President Churchill, in his address at the opening of the Engineering Association convention yesterday, dwelt forcibly on the need for more scientific study and handling of engineering and maintenance of way problems, especially that of labor. In the discussion of one of the reports on Rules and Organization, Edwin F. Wendt quoted from the last report of the Block Signal and Train Board the board's statement that "on the large majority of American railroads excellence of administration is nullified by faulty organization, magnification of individual function to the detriment of team work, and by an almost entire absence of a definite system of broad training of subordinates for higher duties." Commenting on the foregoing, Mr. Wendt expressed the opinion that "the study of the principles which underlie organization would be a proper work for this association. I think," Mr. Wendt added, "that this committee should study what is called the 'science of organization.'"

The Block Signal Board, in the sentence quoted by Mr. Wendt, diagnosed the cause of some of the greatest shortcomings of railway operation in this country, and President Churchill and Mr. Wendt suggested the remedy for those shortcomings. Doubtless, Mr. Wendt meant the study he suggested to relate more especially to the improvements in organization needed to increase the efficiency of the engineering and maintenance of way departments; but the same remedy could be beneficially applied to all departments.

There are really two kinds of engineering—the engineering of materials and the engineering of men. The engineering of men includes the best practicable selection, training and supervision of all officers and employes from the top to the bottom; and from a purely financial standpoint it is a more important branch of railway engineering than the engineering of materials. There is plenty of discussion of the proper form of railway organization; but it really is more important to have an organization worked the best way it can be than it is to give it the best practicable form. It is not so important, after all, to whom the roadmaster reports as it is that whomever the roadmasters report to shall select and train them and supervise their work with the greatest practicable care, consideration, intelligence and thoroughness. There is plenty of "rawhiding" in the railway business, but there often is not enough done to get and develop the kind of subordinate officers and employes who will not have to be "rawhided."

The political history of the world shows that democracy is a better form of government than monarchy; but it also shows that some peoples have been very well-governed under monarchy and others very ill-governed under democracy. The same principle applies to industrial organization. The functioning of an organization is even more important than its structure, and study of the "science of organization" as applied to the railways must, if it is to be useful, get below the surface and find out why in many cases organizations of widely different forms fail equally to satisfactorily perform their function. We believe that such a study will show that one main trouble with railway operation in the United States is that the present organizations, whatever their form, usually do not make provision for adequate supervision, including under this head selection, training and direction of subordinate officers and employment of a sufficient number of such officers.

It is a circumstance fortunate and inspiring hope that two men so prominent in the association as the president and

Mr. Wendt have both directed the thoughts of the members along this channel.

PRESIDENT'S RECEPTION AND MR. McNAB'S ADDRESS.

The president and board of direction of the American Railway Engineering Association tendered a reception to the members, ladies and guests in the Gold room of the Congress hotel last night. Although this is the first year that a reception of this kind has been held, the attendance was gratifying to the committee in charge, particularly on account of the number of ladies who were present. It is expected that it may become an annual feature which will be as popular as the banquet and that the ladies may be induced to come to the annual meeting in increasingly large numbers.

President Churchill and the members of the board of direction began receiving the guests about 8 o'clock and as the crowd gathered, they were entertained by vocal and instrumental music. Kloer's orchestra, which has been furnishing music for the banquet for several years, was present, and Sybil Sammis McDermaid, a soprano of note in Chicago musical circles, sang a number of selections, among which was one Scotch air, rendered by request in honor of the speaker of the evening. A baritone solo, with orchestra accompaniment, was also a feature of this part of the entertainment.

The talk on the Panama Canal by William McNab, principal assistant engineer of the Grand Trunk, and past-president of the association, was presented in his usual happy style and was much appreciated. It was illustrated by a number of excellent stereopticon slides, through the courtesy of the government officials in Washington. Mr. McNab is familiar with conditions on the Isthmus as a result of his visits there, and having recently returned from a trip to the canal was able to give recent and authoritative facts concerning the work. His address was full of information of peculiar interest to engineers, although it was presented in such a manner as to hold the interested attention of all the ladies present.

By way of opening his discussion, he expressly disavowed any intention to mention politics, treaties or commerce, preferring to confine himself closely to the engineering features of the work. In his introductory remarks concerning the history of the project, he paid a high tribute to John F. Wallace and John F. Stevens, former chief engineers in charge of the construction, who did much to make possible the successful prosecution of the work under later administrations. Mr. Wallace was the first president of the association and is well known to many of the present members. Mr. McNab gave due credit to the administration of sanitary regulations on the Canal Zone, quoting several verses of the "Song of the Prickly Heat" to show how important these preliminary measures were to make that tropical region safe for the Americans who have gone there to work.

The construction features were divided into three heads, the excavation of Culebra cut, the building of the locks, and the construction of Gatun dam.

The pictures of the big cut made clear the importance of the 400 miles of railway for work trains which were required to remove the excavated material. Recent photographs of the locks served to give an impression of the magnitude of these structures and the work of building the dam which will impound the waters of the Chagres river to form an immense lake was well illustrated by a number of other views.

Mr. McNab, in closing his remarks, advised those who contemplate making a trip to the Canal Zone to go before the water is turned in, as the interesting features will practically all be covered up after that time, and visitors will find, instead of a great engineering project, only a tropical lake with abundant vegetation. He suggested, however, that if any of the members present were so delayed in reaching Panama as to miss the interesting sights there, they can return home by a new transcontinental route, which will be completed in the not very distant future, along which will be found scenery as interesting as any on this continent. By way of proof of this assertion, he had thrown on the screen a number of beautifully colored views of the Canadian Rockies along the new Pacific coast extension of the Grand Trunk. These views had never before been shown and were very much appreciated.

TO-DAY'S PROGRAMME.

XVI.	Economics of Railway Location	Bulletin 153
VII.	Wooden Bridges and Trestles	Bulletin 153
Special.	Uniform General Contract Forms	Bulletin 153
XVII.	Wood Preservation	Bulletin 153
III.	Ties	Bulletin 153
IX.	Signs, Fences and Crossings	Bulletin 153
VIII.	Masonry	Bulletin 153
	Annual Dinner at 7:00 P. M.	

ANNUAL MEETING RAILWAY APPLIANCES ASSOCIATION.

At the annual meeting of the National Railway Appliances Association, held Tuesday morning at the Coliseum, there was a larger attendance than usual. President A. P. Van Schaick presided. In his annual report Mr. Van Schaick called attention to the noticeable increase in interest in the exhibits each year on the part of the railway men. He stated that next year the association might be compelled to also lease the new Wilson building, near the Coliseum, in order to provide additional exhibit space to meet the constantly increasing demand.

T. W. Snow, chairman of the nominating committee, reported the following selections for officers of the Association for the coming year:

President, T. R. Wyles, Detroit Graphite Co., Chicago.

Vice-President, N. M. Hench, Carnegie Steel Co., Pittsburgh.

Treasurer, John N. Reynolds, Railway Age Gazette, Chicago.

New members of the board of directors, for three years, J. Alexander Brown, Pocket List of Railroad Officials, New York, and E. H. Bell, Railroad Supply Co., Chicago; for one year, E. E. Hudson, Thomas Edison, Inc., Orange, New Jersey.

Treasurer Reynolds reported that at the end of the fiscal year, April 30, 1912, the Association's assets amounted to $13,225.37, with no liabilities.

1,574 INVENTORS WANT MR. MELLEN'S $10,000.

The $10,000 reward for a successful automatic train stop offered by President Mellen of the New York, New Haven & Hartford a short time ago brought replies from 1,574 inventors. Each applicant was sent a printed list of the conditions which the devices are required to meet. Over 500 replies were received to this circular, and of those who took this second step in the matter, over 95 per cent failed to comply with the very first condition, let alone the other 17.

Altogether there were 1,480 holders of patents among those who sought the reward. They were from all walks and conditions of life and from all grades of intelligence, experience and education—and all grades of a lack of it. Out of the whole number, two devices have been selected for testing, and experimental installations will be made in the near future.

Four replies came from inmates of insane asylums; four

from men serving time in states' prisons; one from a monastery, and one from a man who said he had received a revelation from Heaven in which it was explained to him that anything he took up would be successful. The last-named desired to get a trial of a friend's device, and assured the New Haven that if the said friend secured the $10,000 he only expected $1,000 as commission for the use of his revelation.

Replies came from Panama, Porto Rico, Jamaica, Belgium, France, Ireland, Hawaiian Islands, England, Scotland, Wales, Germany and Denmark, and several other countries.

One inventor's scheme would, in his words, "constitute no source of danger to the passengers, but would probably kill the engineer and fireman. "However," he continued, "since it is to be used on the New Haven, it won't make any difference." Another scheme provided a heavy spring equipped with a hook, which would rise in the center of the track as soon as the train passed. Any following train trying to enter the occupied block would be stopped by the hook firmly grasping the nearest axle and holding the train.

The letter setting forth the 18 conditions to be complied with was answered by one man as follows: "I accept your offer of the $10,000. Please send a check." Another inventor said, "Send me the $10,000, and pay me a retainer's fee and expeness, and I will come down and design you an automatic stop."

The time for filing applications expires on July 1, 1913, and no devices received after that date will be given consideration in connection with the $10,000 reward.

NORFOLK & WESTERN LETS CONTRACTS FOR DOUBLE TRACKING.

The Norfolk & Western has let contracts for double tracking 61 miles of line on its eastern section and for the masonry work on a new double track bridge, to replace the high bridge over the Appomattox river.

BALTIMORE & OHIO ANNUAL DINNER.

The officers of the Baltimore & Ohio in attendance upon the convention will have their annual dinner this noon. This road has maintained a very creditable record for a number of years as regards the large number of men attending the convention, and their dinner in connection with the convention has been an annual event for some years.

CONFERENCE REGARDING DENVER UNION STATION.

A conference of officers of the railways entering Denver, Colo., regarding the matter of the construction of a new union station at that city was held in Chicago yesterday. Among those attending the conference were D. Miller, president of the Burlington; H. U. Mudge, president of the Rock Island Lines; A. L. Mohler, president of the Union Pacific; A. D. Parker, vice-president of the Colorado & Southern; W. B. Storey, Jr., vice-president of the Santa Fe, and E. L. Brown, vice-president of the Denver & Rio Grande.

W. S. DAWLEY TO RETURN TO UNITED STATES.

F. W. Hawks, formerly assistant chief engineer of the Unnan-Fur-Szech-Uan Railway, in Unnan-Fur province, in Southern China, is attending the convention.

Mr. Hawks reports that W. S. Dawley, who is now chief engineer of the Unnan-Fur-Szech-Uan Railway, and who formerly was chief engineer of the Chicago & Eastern Illinois, expects to return to the United States next summer, leaving China in June.

Mr. Dawley, it will be recalled, was treasurer of the Engineering Association for several years. Prior to going to China he was with the Evansville & Terre Haute and before that with the Virginian Railway.

REFERRED TO ARRANGEMENTS COMMITTEE.

One of the incidents which occasionally relieve the strain of a serious discussion was precipitated by C. E. Lindsay, division engineer of the New York Central & Hudson River, during the discussion on the Iron and Steel Structures report. Paragraph 34 of the "Instructions for the Inspection of the Fabrication of Steel Bridges" read, "Have important members so loaded as to be headed in the right direction upon arrival at the site of the work." Mr. Lindsay suggested after the reading of this paragraph that it be referred to the Committee on Arrangements.

NEW FIRM OF CONSULTING ENGINEERS.

C. P. Howard, locating engineer of the Canadian Pacific, and S. S. Roberts, division engineer of construction, Illinois Central, have organized a new firm of civil and consulting engineers, to be known as Howard & Roberts. Both men have had extensive experience in railroad location and construction and expect to specialize in railway surveys, locations, re-surveys, grade revision and terminal developments. The company has offices at room 1662, Transportation building, Chicago.

MEMBERSHIP OF AMERICAN RAILWAY ENGINEERING ASSOCIATION.

The secretary's report showed that the total membership of the association on December 31, 1912, was 1,066, as compared with 1,004 on December 31, 1911. During 1912 there were 5 deaths of members, 12 withdrawals and 23 were dropped for non-payment of dues, while there were 102 additions.

The following table shows the geographical distribution of the membership:

United States	925	Peru	2
Dominion of Canada	91	Philippine Islands	2
Japan	8	Australia	1
China	7	Bolivia	1
Mexico	6	Brazil	1
Cuba	5	Korea	1
Central America	4	Panama	1
New Zealand	4	Porto Rico	1
Argentine Republic	2	Russia	1
Great Britain	2	Uruguay	1
Total			1,066

NEW WORK FOR THE QUEEN & CRESCENT.

Announcement has been made that the Cincinnati, New Orleans & Texas Pacific will build eight new tracks and rearrange its present tracks in the McLean avenue yard at Cincinnati.

B. M. McDade, manager railroad department Detroit White Lead Works, Detroit, Mich., which is attending the convention, announces the appointment of William B. Wise as manager Eastern district at New York.

Proceedings.

The first session of the fourteenth annual convention of the American Railway Engineering Association was called to order at 9:30 a. m. on Tuesday, March 18, in the Florentine room of the Congress Hotel, by the president, Chas. S. Churchill, chief engineer, Norfolk & Western, Roanoke, Va.

The minutes of the last convention were approved as printed.

PRESIDENT'S ADDRESS.

At the last annual convention our membership aggregated 1,004. During the past year there has been an increase of 62, making a total of 1,066. The number of printed pages issued during the year was as follows:

In Bulletins		1,542 pages
In Proceedings		1,364 pages
In Manual	136	
Program, and	56	
Miscellaneous	128	320 pages
Total		3,226 pages
The aggregate to date by this Association is therefore		30,366 pages

The Association was invited to be represented at the Fourth National Conservation Congress held at Indianapolis in September, 1912. Messrs. McNab, Atwood, Ferriday, Fink and Young were appointed as delegates to attend that congress.

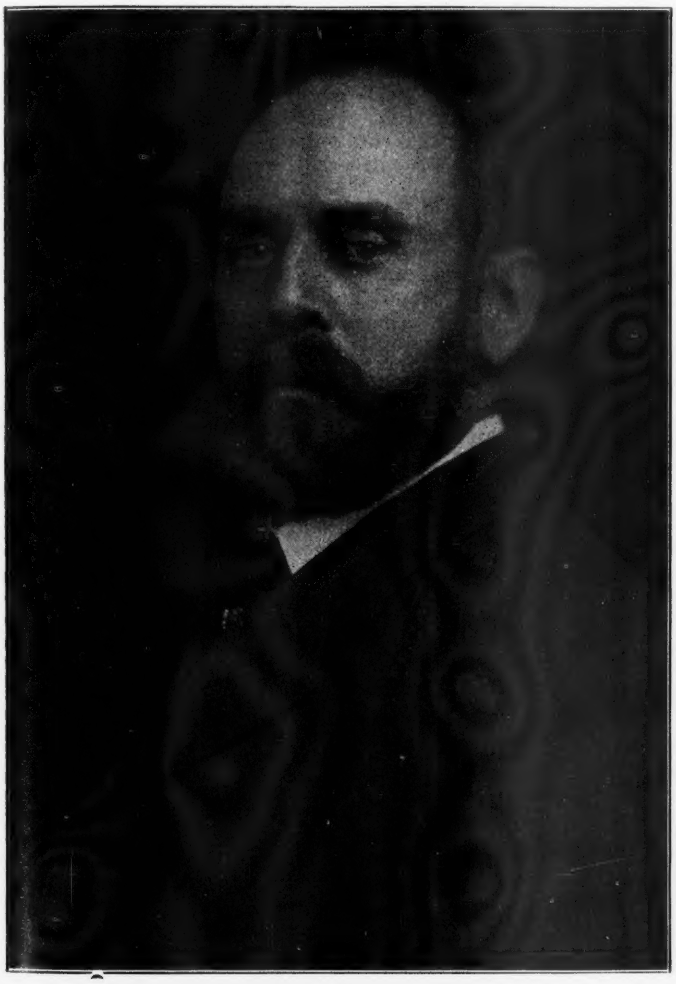
With the completion of another year in the existence of the American Railway Engineering Association, it is well to review its accomplishments and to point out the work before it.

Its first notable accomplishment has been:

The standardization of materials, designs, specifications and records used in the construction and maintenance of the various parts of a railroad. Progress has been made in the specifications governing the making of such complex materials (so largely used by railroads) as concrete and steel.

While the first of these items relates almost wholly to materials, the proper use of these materials is largely dependent upon labor, skillfully and economically directed; and the second item—namely, the manufacture of such materials as concrete and steel, is very greatly dependent upon the quality of the labor and upon the honest and thorough use of it.

This Association has had before its committees instances of the short life of concrete, due more often to faulty or dis-



CHARLES S. CHURCHILL, President.

EDWIN F. WENDT, First Vice-President.

The various methods reported upon at the last convention for increasing revenues, especially those procurable by economies, have been carried out with the result that on January 1, 1913, our cash on hand was $3,183.11 in excess of what it was on January 1, 1912. The secretary estimates that the proceedings of this convention will be issued about May 1. The credit for this belongs to your secretary, your committee on publication and to your editor, Prof. W. D. Pence.

The American Railway Association has made the following appropriations on account of the investigations of the rail committee: In 1910—$5,000; in 1911—$6,000; in 1912—$10,000, making a total of $21,000, and in November, 1912, a further appropriation of $10,000 was made for the work of 1913, bringing the total up to $31,000. Against this appropriation there had been expended up to November, 1912, $21,011.41.

honest labor used, than to the materials themselves composing it; yet so far, more concern has been given by this Association to the materials than to the labor. The discovery of voids in concrete, or of portions where adhesion is lacking, or again of the misuse or damage by laborers of reinforcing materials, has resulted in the gradual increase in the amount of skilled labor and of supervision employed; because, after all, a mass of concrete is only as strong as its weakest part.

The manufacture of steel likewise demands employment of skilled labor in every step of the process. The time was when certain ores of generally known quality when handled and reduced to steel by a method in general practice was all that was necessary; and the product received its name and often its rate value from the record of the individual manufacturers. That time is gone. Labor used instead of

being small in numbers is both large and changeable; so, skillful labor and the efficient use of it, as well as of the extensive mechanisms under its control, is the only surety for a steel that will be uniform in good quality. The rail committee of this Association has brought out this point very forcibly to railroad people and to the manufacturers of rail, as well as to the public.

It has been found that it is those mills which have sought for scientific care on the part of their men, and which have discharged others for carelessness, or for a misguided loyalty to their employer in their effort to produce quantity at the risk of slighting quality, that are to-day producing rails of the more uniform grade. It is by this method of extreme watchfulness that further improvement will be obtained.

The rail committee has shown so far:

First.—That while rail failures in the past have had as many explanations as there were manufacturers, with no means of proving or disproving any of them, now we know the general causes, and the remedies are being worked upon.

Second.—Many negative results of the investigations prove that good or bad mill work produces good or bad rails, and in many cases overcome the advantages or disadvantages of any particular rail section.

Third.—That the amount of discard from the top of ingots does not set a gage on either the high standard of the rail produced, or on the number of rail failures; but rather indicates the relative skill of some mills in controlling the chemical content, casting ingots and rolling rails.

Fourth.—That some mills continuously produce better or more uniform material than others; and that this uniformity is largely the result of greater care and skill at the mills, which has been considerably developed by the publications of this Association.

Fifth.—And now we are finding that the use of thick base rails of the A. R. A.—"B" type is reducing base failures to an insignificant number; and also that care in handling and using rails is productive of both longevity and safety. In fact, that careful labor should follow the treatment of rails until they are removed from main tracks.

To explain one type of watchful labor in detail: About two years ago a broken wheel nicked the rails of over a mile of track on an important railroad. The nicked rails began to break under following trains before their replacement could be completed. It seems important, therefore, that track supervisors should promptly remove rails nicked by broken wheels whenever discovered in main tracks.

It is proper here to place on record the fact that James E. Howard, of the United States Bureau of Standards, has personally complimented the work of this Association on the subject of rails, and it seems well also to call your attention to a recent report of the National Association of Railway Commissioners, by its special committee, to whom was assigned the question of equipment and rails. In this report many quotations are included from the Proceedings of the American Railway Engineering Association, and the following statement is made:

"The best general information obtainable on the subject for the country as a whole will be found in the reports of the rail committee of the American Railway Engineering Association. The care which has been used in obtaining statistics of rail failures by this committee, in analyzing these figures, and in fearlessly reporting its conclusions, justifies high praise."

This problem is a complex and difficult one, but its solution is approaching; and very fortunate will be that mill, or group of mills, that first proves that it is delivering tougher and more uniform rails than are now produced.

This Association should keep up to date in labor-saving machinery and devices, and should discover and compile records of the best practice in handling labor with and without their use. It should also refer to its quality and the economical seasons for its employment, as well as to its best supervision in all branches of railroad construction, maintenance and operation.

One of the best ways for securing efficient results from labor is to freely recognize any improvement that its intelligent use produces. An employer that always points out the fault only, without commending the gain, soon discourages even the most skilled of artisans. Humanity in general needs incentive and encouragement in addition to wages.

We, in America, have made great strides in methods of getting work done; but we cannot afford to overlook the song of the leader of the boat crew on the Mediterranean who keeps the men at vigorous stroke by his frequent exclamation "Glory to Allah." These are both examples of good "team work."

Some railroads adopt a prize system in one or more branches of service. There is no single department that will answer more readily to this system than the labor employed upon the maintenance of track. The Pennsylvania, for example, has a special committee of maintenance of way officers to look after the award of premiums for the maintenance of track and roadbed, which award is finally made after an annual inspection of the road by a large number of its operating officers.

The road with which I am connected has used this plan in a modified form for a long period. Its annual inspection awards upon 2,000 miles of railroad last year cost for prizes less than $1,500. This, however, was not a track inspection by officials, but one of roadmasters and track foremen taken from one district to inspect quite another. Not only have these awards been just, but each individual has learned many of the good points found on the other district. Such an inspection is a method of indirect but very effective instruction.

There is an economic cost for putting a new tie in place in the track of every district of a railroad, likewise a corresponding one for putting bridge timbers or steel in place, for laying stone masonry, or depositing concrete. The distribution among the districts of each railroad of the costs secured each month is a great incentive itself in track and other classes of maintenance labor, as also in other departments of railroad service.

If we, for a moment, turn back a dozen years and see how little standardization there existed on railroads as a whole, and how little general information was distributed; and compare that with the mass of valuable information in our Manual and Proceedings, we may realize that there must be likewise a large amount of data as to labor and mechanical appliances for cheapening the use and handling of materials that may be compiled in the same manner. This is of special importance as the unit cost of labor is increasing very rapidly.

The changes in ideas and methods in this branch of economy will be frequent and often great from year to year. Committees can never expect, therefore, to complete this subject. They will, when fully organized in collecting this kind of data, have some new economies to report each year in every branch of the service. The study of this line of economies often leads to what at first thought appears to be bold undertakings.

As examples to be mentioned because of personal knowledge of the details:

The Norfolk & Western has just successfully swung, under the method of cantilever erection, the central and last span, 520 ft. long, being one of a total of five double tracked spans of bridge forming its crossing of the Ohio River. These spans were built around the old spans and rest on the original masonry. The original spans carried the dense traffic until they were replaced. The consideration that led to this novel construction were economy in time and labor combined with the least delays to railroad traffic and none to river traffic.

Another study on similar lines of economy of labor and efficiency mostly, which has been under progress in the engineering department of the same road since 1905, has just culminated in the undertaking of electrification of 27 miles of that portion of its line having the steepest grades and densest business in the heart of the Pocahontas coal field, purely for handling freight traffic most economically.

We should always bear in mind that any saving in cost of labor applying materials is net income to a railroad, just the same as is the saving in overtime charges in handling trains gained either through improvements in grades or in motive power, or through efficient block signals.

In traveling about over various railroad lines, I have observed forces of men employed thereon that do not seem to differ much in number; but there was noticed at the same time a difference in the appearance of the railroads, even to the extent of a large percentage. Close investigations of both the labor employed and the business handled in many cases reveal the fact that for the corresponding amount of traffic the best appearing railroad accomplished its maintenance work at the lower cost. The explanation is simply that it is just as easy and no more expensive to work to a definite line or plan than to a random one; and if this method is followed uniformly on every district of a railroad, any given standard can be acquired without cost.

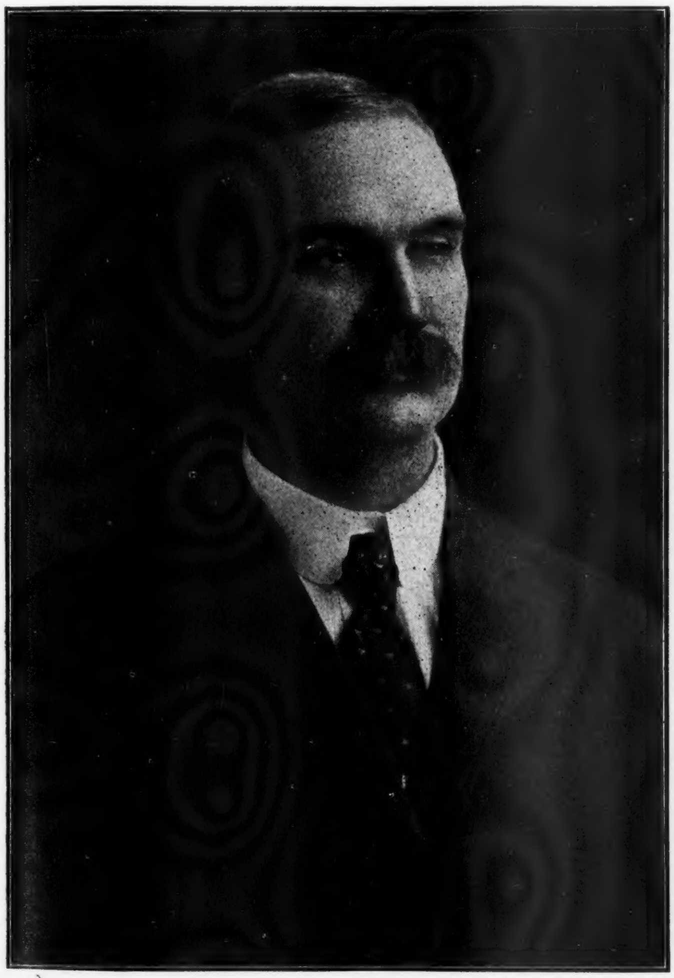
One of the leading officials of a great concern was heard some time ago to say: "We have let one-fourth of our men go; the other three-fourths have since gotten busy, and we are securing great results." While this did not speak well for the past of that concern, it also proved the fact that there was a large number of unproductive employes, who, if they

had been always well directed, would have added greatly to the stability and value of that property.

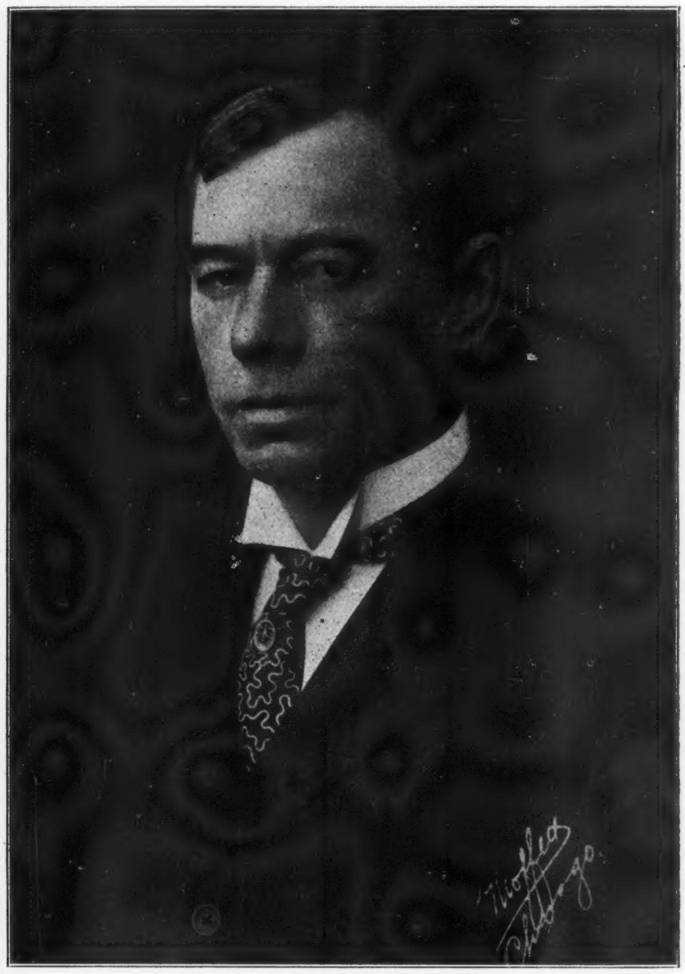
A number of years ago we had occasion to have railroad ties condemned as first class because they were of variable lengths and presented a bad appearance in track. Many have been satisfied to condemn only when too short. But I submit it is just as easy to have them cut by the makers practically to the right length.

These illustrations show how we can make our permanent way and track in a period of years things of strength, safety and beauty through uniformity acquired without cost except in the time of skillful directors and in the abundance of standard plans and constructive forms economically followed.

Gentlemen, this is part of our work. We are directors of the economical and efficient expenditure of money. We should hesitate to ask for more till we have shown that we are using that in hand to the best advantage, or until we can prove that we can secure a fair percentage of earning from the additional amount requested. The American Railway Engineering Association can aid in the development of skill in labor efficiency just as it has developed and must continue to improve the standards of materials and specifications.



GEORGE H. BREMNER, Treasurer.



E. H. FRITCH, Secretary.

Reports of Secretary and Treasurer.

Balance on hand December 31, 1911		$ 7,562.15
Consisting of:		
Six railway bonds	$ 5,206.06	
Cash in bank	2,356.09	
Total	$ 7,562.15	
Receipts during the year 1912:		
From members	$13,363.25	
From others—sales of publications, advertising, etc.	6,111.19	
From Am. Ry Assn., Rail Com. fund	7,961.81	
From interest on bank balance	123.66	
From interest on investments	280.00	
Total receipts in 1912	$27,839.91	

Summary.

Receipts during 1912		$27,839.91	
Expenditures:			
Dec. 1911 vouchers, paid Jan. 4, 1912		1,047.68	
Vouchers for 1912	$23,609.12	24,656.80	
Excess of receipts over expenditures		3,183.11	3,183.11
Assets December 31, 1912			10,745.26
Consisting of:			
Six railway bonds		$ 5,206.06	
Cash in bank		5,539.20	
Total		$10,745.26	

RULES AND ORGANIZATION.

Last year's report consisted in the presentation of a number of rules regarding the government of employes and the conduct of work of the maintenance of way department.

The subjects assigned the committee for this year were to continue the work of last year, including: the compilation of rules for the government of maintenance of way employes, and the formulation of rules in the nature of specifications or instructions regarding the conduct of work, making use of the recommendations of the various committees dealing with these subjects and of the best practice of railway companies as embodied in their books of rules.

In accordance with the first instruction, the committee recommends that revisions and additions be made in the General Rules for the Government of Employes of the Maintenance of Way Department heretofore adopted by the Association, as follows:

Revise rule No. 8 under "Track Supervisors," "Track Foremen," "Supervisors of Structures," "Bridge and Building Foremen," "Signal Supervisors" and "Signal Foremen" to read as follows:

(8) They shall conform to the prescribed standards, plans

and specifications in the execution of the work under their charge.

Insert under "Track Foremen" a rule to be No. 17 and reading as follows:

They must keep all interlocking pipe lines and trunking free from grass and weeds and all switches, frogs and movable parts of interlocking plants free from snow, ice and other obstructions.

Under "Track Foremen," change rule No. 17 to be No. 18.

Insert a rule under "Track Supervisors" to be No. 17 and under "Track Foremen" to be No. 19 to read as follows:

Any action proposed by county, township, municipal or other authority, which will in any way affect the company, shall be reported immediately to the..................

Insert under General Notice rules to be No. 12 and No. 13 and reading as follows:

(12) The use of intoxicants by employes while on duty is prohibited. Their use, or the frequenting of places where they are sold, is sufficient cause for dismissal.

(13) Employes subject to emergency call shall notify their immediate superior officer and the division superintendent of any change in address, whether temporary or permanent.

In accordance with the second instruction, the committee recommends that the following rules be added to the "Instructions" which were presented and adopted by the Association at its convention of last year. In preparing these rules the specifications have been taken wherever possible from the approved recommendations of the other committees of

J. O. OSGOOD,
Chairman Committee on Rules and Organization.

the Association, the wording only being changed, where necessary, to conform to that of the other rules.

Tie-Plates.

27. Tie-plates must be used wherever ties wear out faster than they fail by ordinary decay. They must be put on so as to get a full and level bearing on the tie and against the rail.

Gaging.

28. Perfect gage is one of the essential features of good track; gage kinks are as detrimental as low joints.

29. The standard gage is 4 ft. 8½ in. Curves 8 deg. and under should be standard gage. Gage should be widened ⅛ in. for each 2 deg. or fraction thereof, over 8 to a maximum of 4 ft. 9¼ in. for tracks of standard gage. Gage, including widening due to wear, should never exceed 4 ft. 9½ in.

30. The installation of frogs upon the inside of curves is to be avoided wherever practicable; where this is unavoidable the gage of the track at the frog should be standard.

Curve Easement.

31. On all curves the amount of super-elevation to be given to the outer rail and the proper easement to be provided at the ends shall conform to the standards for "Track" as prescribed by the American Railway Engineering Association and published in the manual, edition of 1911.

Switches.

32. Switches must be placed in accordance with the standard plans and as located by the engineer.

33. Switches and frogs must be kept well lined and in good order. Particular care must be taken to maintain good surface at switches.

34. Switches must be inspected frequently to see that they are in working order and that all nuts, bolts and other fastenings are in place and properly tightened. Broken or damaged parts must be renewed promptly.

35. Switch points must fit closely and accurately to the stock rail, which must be bent to suit the angle of the switch. The bend in the stock rail shall be at such distance ahead of the switch point as will make the gage line continuous.

36. Lead rails in all turnouts must be curved with a rail bender before being laid.

37. All main track switches leading to sidings or branch lines should be protected by switch connected derails.

Switch Ties.

38. Switch ties must be used for all permanent turnouts, crossovers and railroad crossings and placed as shown on the standard plans.

Guard Rails.

39. Frogs must be protected by guard rails, constructed and placed in accordance with standard plans. The tops of the guard rails must be level with the tops of the main rails and must be securely held in place.

40. Guard rails must be so placed that the distance from the gage side of the head of the frog wing rail to the flangeway side of the guard rail shall be exactly 4 ft. 6¾ in., and great care must be taken to preserve this distance.

Track Posts and Signs.

41. All signal posts, whistle posts, mile posts, signal targets, bridge and other standard signs must be kept plumb and in good condition.

42. Whistle posts must be placed so as not to be obscured by fences or other signs.

Care of Track Tools.

43. Tools must not be left standing within 6 ft. of the nearest rail of the track on which a train is approaching.

Road Crossings.

44. Road and street crossings must be constructed as shown on the standard plans and kept in good order.

45. Particular care must be taken to remove as far as practicable all obstacles which obstruct the view of crossing signs and approaching trains.

46. Flangeways must be kept clear of rubbish, snow, ice and other obstructions; defective crossing planks must be repaired promptly.

Platforms.

47. Station platforms must be kept clean, free from rubbish, snow and ice, and in good order.

48. Defective platforms must be promptly repaired or reported.

Fences and Cattle-Guards.

49. Fences and gates along the right-of-way shall be kept in repair and all gates kept closed when they are not in actual use.

50. Cattle-guards must be kept in repair and at all times free from dirt, rubbish and other obstructions.

Track Jacks.

51. Track jacks must not be used between the rails of main tracks, except in unavoidable cases; the track must then be properly protected as in the case of other obstructions.

RULES GOVERNING THE USE OF STOP AND CAUTIONARY SIGNALS FOR THE PROTECTION OF UNSAFE AND OBSTRUCTED TRACK.

Flagging.

52. In case of impassable track, flagging is the first duty, and repairs must wait, if necessary, until signals have been placed.

Flagging Before Obstructing Track.

53. The track must never be obstructed without first displaying stop signals not less than 20 telegraph poles in each direction from the point of obstruction. Stop signals must be in the hands of reliable men. Flagmen must stop all trains and explain to the engineman the nature of the obstruction and its exact location.

Slow Orders.

54. When the track is not in condition for the passage of trains at the usual rate of speed, and this condition will

Convention of the American Railway Engineering Association in Session.

continue over night or for the greater portion of a day, notice must be given immediately to the.................. In such notices the place of danger, its nature, and the speed at which trains may pass must be stated.

In addition to sending this notice, slow (color) signals must be displayed. When repairs have been made the person making them must at once notify the...................... that the slow order may be recalled.

Signals to Be Used.

55. The color, hand, flag, lamp and engine steam whistle signals, and the train markers prescribed by and published in the standard code of American Railway Association shall be used. It is suggested that copies of the description and rules for the use of these signals, including diagrams, be inserted in books of rules governing maintenance of way employes.

Time for Obstructing Track.

56. All work which will obstruct the track must be done at such times as will interfere as little as practicable with the passage of trains.

Obstructing Track in Storm or Fog.

57. Except in case of emergency, no work that will obstruct the track shall be done during fogs or storms.

Signals in Obscure Weather.

58. In obscure weather, or on heavy grades or curves, extraordinary care must be taken to make sure that the stop signals are out a sufficient distance in both directions to insure full protection.

Proper Maintenance of Signals.

59. While working under the protection of signals, great care shall be taken that the signals are intact and in their proper location and position. Disregard of signals shall be promptly reported to the ....

Signals for Double Track.

60. In using signals on double track, each track must be considered as a single track railroad upon which trains are likely to be run in either direction at any time.

RULES GOVERNING THE USE OF HAND, PUSH, MOTOR AND VELOCIPEDE CARS.

61. Care must be exercised by foremen and other employes in the use of hand, push, motor and velocipede cars. In order to avoid accident, they must protect themselves with the proper signals, when the view is obstructed. On moving hand cars at least one man must face the rear to look out for approaching trains.

62. Such cars must be protected from the weather and when not in use must be locked.

63. Cars must never be used or left on the main tracks or sidings unprotected. Loaded hand or push cars on the track are obstructions and must be protected by the proper signals.

64. They must not be attached to trains. When following trains, or other moving cars, they must not run closer than ten rail lengths.

65. They must be kept in good order and inspected frequently for loose bolts or other defects.

66. Switches must not be thrown for such cars, unless loaded, and then only under the supervision of the foreman.

NEXT YEAR'S WORK.

For next year's work the committee recommends that it be instructed to review the rules and instructions heretofore adopted by the Association and to recommend such changes and additions thereto as may seem desirable.

Jos. O. Osgood (C. R. R. of H. S.), chairman; G. D. Brooke (B. & O.), vice-chairman; F. D. Anthony (D. & H.), J. B. Carothers (B. & O.), S. E. Coombs (N. Y. C. & H. R.), J. B. Dickson (Erie), C. Dougherty (C. N. O. & T. P.), W. T. Eaton (St. L. S. W.), J. A. Gordon (P. M.), K. H. Hanger (C. R. I. & P.), B. Herman (Southern), Jos. Mullen (C. C. C. & St. L.), E. T. Reisler (L. V.), A. F. Stewart (C. N.), Committee.

Discussion on Rules and Organization.

In the absence of the chairman, Mr. Osgood, the report was presented by Mr. Brooke.

L. C. Fritch (C. G. W.): I would suggest that the "State" be included in the new Rule 18. It covers every sub-division except the state. Very often employes to whom this is directed have information in regard to any state action taken.

The President: The committee would accept that modification, to insert the word state before county.

After considerable discussion it was voted that Rule 27 be changed to read as follows: "When tie-plates are used they shall be applied so as to secure a full bearing upon the tie and for the rail."

L. S. Rose (Big Four): I move that the second half of Rule 28 referring to "gage kinks are as detrimental as low joints" be cut out. It depends on what a gage kink is. I do not believe you can prove that a gage kink is more detrimental than a low joint. (The motion was carrried.)

Albert Swartz (Toledo Rys.): We might say, "Perfect gage is on of the essential features of good track and must be maintained."

The President: The committee is willing to accept the suggestion of Mr. Swartz.

Rule 30.

H. R. Safford (Grand Trunk): Is Rule 30 a proper rule to put under instructions to the section foremen on the theory that the location of the switch is a matter which is not left to the judgment of the section foreman. It is always prescribed by the higher officer, generally the engineer in charge of maintenance on the division.

T. S. Stevens (Santa Fe): I believe that if the standard prescribed by the committee is good the widest publicity we can give to it, is desirable, and it is just as well to have the section foreman know what the standard is, as the division engineer, with the idea that perhaps some time or other the section foreman may be able to check up the division engineer, in some probable error he has been led into by mistake.

The rule was adopted as read.

The last two lines of Rule 31 after the word "standards" was omitted and the rule was changed to read "On all curves the amount of super-elevation to be given to the outer rail and the proper easement to be provided at the ends shall conform to the standards," and a notation in parenthesis will refer to the standards of the Association.

J. A. Atwood (P. & L. E.): I move the adoption of Rule 34 in the form submitted by the committee, the only changes being the addition of the words "and frogs" at the heading of the rule. (The motion was adopted.)

S. S. Roberts (I. C.): Rule 35 as it stands is rather indefinite, and inasmuch as most roads have a specific distance ahead of the switch point for bending a stock rail and as this committee has recommended a certain distance ahead of the stock rail, I move the rule should read "switch points must fit closely and accurately to the stock rail, and the stock rail must be bent in accordance with the standards." Then in parenthesis refer to the recommendations of the track committee of this association. (The motion was carried.)

Rules 36 and 37 were voted to be stricken out.

A. Swartz (Toledo Ry.): Referring to Rule 38, I do not believe it is good practice to use switch ties on railroad crossings. We generally use a heavier timber than switch ties.

G. W. Bremner (C. B. & Q.): I think this ought to refer to the standards of the track committee also.

The President: The committee will accept that and put a note, referring again to the standard practice of this association.

Section 40.

Mr. Brooke: The committee has a communication from Mr. A. M. Shurtleff, suggesting Section 40 should read as follows:

"Guard rails must be so placed that the gage distance from the frog point to the flangeway side of the guard rail shall be at least 4 ft. 6¾ in., and the distance between the flangeway sides of the wing rail and guard rail shall not exceed 4 ft. 5 in."

(The committee accepted this amended reading and it was adopted.)

C. E. Lindsay (N. Y. C. & H. R.): I think that Section 42 should read—"All signal posts, whistle posts, etc., must be placed so that they will not be obscured."

The President: The committee accepts the change to Section 42.

Mr. Lindsay: I think that Section 43 should read, "Tools should not be left where they are liable to be struck by trains." (This was adopted by a rising vote.)

John R. Leighty (Mo. Pac.): I would suggest that we add to Rule 49 as it stands, that a report be made to the proper officer, of all gates which are habitually left open. (The motion was seconded and carried.)

Mr. Lindsay: The latter part of Section 51 is rather indefinite. I would like to substitute for it the words, "and then only under flag protection as per Rule 53." so

that the rule would read, "Track jacks must not be used between the rails of main tracks, except in unavoidable cases; and then only under flag protection, as per Rule 53." (The motion seconded and was accepted by the committee.)

It was voted that Rule 53 read as follows: "The track must never be obstructed without first displaying stop signals in general accord with Rule 99 of the American Railway Association. Stop signals must be in the hands of reliable men. Flag men must stop all trains, and explain to the engine man, the nature of the obstruction, and its exact location."

In Section 57 the words "In case of" were changed to read, "except emergency."

The following is to be added to Section 58: "Displayed at a proper distance."

Mr. Lindsay: In Section 60 I would like to substitute for "signals on double track"—"signals for multiple track," because we have 4 and 6 track-railroads, and I believe the rule would be better if it said, "Each main track shall be considered as a single track railroad upon which trains are likely to be run in either direction at any time, and signals must be displayed accordingly."

The following was inserted in Rule 63, after the word "sidings": "street or public crossings."

Mr. Lindsay: I would like to confine Rule 66 to main track switches, because in yards it is common practice and always will be, to operate the switch by the man in charge of the car, without the foreman being there. (The committee accepted this change.)

Hunter McDonald (N. C. & St. L.): There is an inconsistency between that and 29. It says, "Perfect gage is one of the essential feautres of good track." I do not know of any road that maintains perfect gage. In Section 29, the words in the last part are as follows: "Gage including widening due to wear" if you are going to admit widening due to wear, which we will necessarily have to do, we cannot have perfect gage, and I move therefore that Section 28 be amended to read: "Uniform gage is essential to good track and must be maintained." (The motion was seconded and carried.)

A. G. Shaver (C. R. I. & P.): I want to call attention to one thing that I believe is lacking in the rules for constructing track, and that is the automatic block signal. In some of the territory of some of the roads, they require the section foreman to assure himself that the signal is at "stop" while the change is being made. It would be a good plan to include something of that kind in connection with these rules.

The President: The committee will take that into consideration.

The rules were tnen adopted as amended, in their entirety.

Edwin F. Wendt (P. & L. E.): Before this committee is dismissed I wish to make a suggestion in connection with the work of next year. Much work has been done in connection with the question of rules, but very little attention has been given to the subject of organization. In reading the final report of the Block Signal and Train Control Board of the United States Government, I was struck with the following statement, "As regards methods, it may be said that on the large majority of American railroads excellence of administration is nullified by faulty organization, magnification of individual function to the detriment of team work, and by an almost entire absence of a definite system of broad training of subordinates for higher duties." It seems to me that our committees might well study the science of organization. Considerable literature has been developed in recent years respecting this question. The study of principles which underlie organization, would be a proper work for this association. I do not refer to those features of organization which give rise to so much discussion. Reference is made to the principles which underlie organization, and I think that this committee should study what is called, "the science of organization."

The President: We will take that up in the committee of the Directory, in assigning subject for the coming year.

Mr. Lindsay: I would like to ask that the committee be asked to prepare and submit to the Association next year, a rule for display of caution signals.

The President: The committee will take that into consideration as part of their instructions for next year.

SIGNALS AND INTERLOCKING.

On Subject No. 1, "Continue investigation of outline description of a comprehensive and uniform signal system, suitable for general adoption, conferring with proper committee of the American Railway Association," the committee submits the following report:

As a result of several years' study, the committee, in 1907, arrived at the conclusion that the basis of a uniform system of signals should be the control of the train. During the succeeding two years the committee ,after exhaustive study and investigation of the subject, was unable to agree,

First—As to the number of indications that should be given by fixed signals;

Second—As to the wording of the indications;

Third—As to the aspects or forms of the signals that should be used to represent the several indications.

In 1910, the American Railway Engineering Association requested the American Railway Association to bring the matter to the attention of its committee on Transportation for decision. The committee on Transportation heard arguments at a meeting in June of that year and reported as follows:

"MEMORANDUM OF THE ESSENTIALS OF SIGNALING,

"Incorporated in the Report of the Committee on Transportation of the American Railway Association, May, 1911.

"The reports of various committees of the Railway Signal Association and of the American Railway Engineering Association on the subject of signaling have been submitted to this committee, with the request that the essentials of signaling be outlined or defined for the future guidance of their committees.

A. H. RUDD,
Chairman Committee on Signals and Interlocking.

"The subject has been carefully analyzed and considered. There are three signals that are essential in operation and therefore fundamental, viz.:

(1) Stop.
(2) Proceed with caution.
(3) Proceed.

"The fundamental, 'proceed with caution,' may be used with the same aspect to govern any cautionary movement; for example, when:

(a) Next signal is 'stop.'
(b) Next signal is 'proceed at low speed.'
(c) Next signal is 'proceed at medium speed.'
(d) A train is in the block.
(e) There may be an obstruction ahead.

"There are two additional indications which may be used where movements are to be made at a restricted speed, viz.:

(4) Proceed at low speed.
(5) Proceed at medium speed.

"Where automatic block system rules are in effect, a

special mark of some distinctive character should be applied at the stop signal.

"The committee therefore recommends:

"Signal Fundamentals.

(1) Stop.
(2) Proceed with caution.
(3) Proceed.

Supplementary Indications to Be Used Where Required.

(4) Proceed at low speed.
(5) Proceed at medium speed.

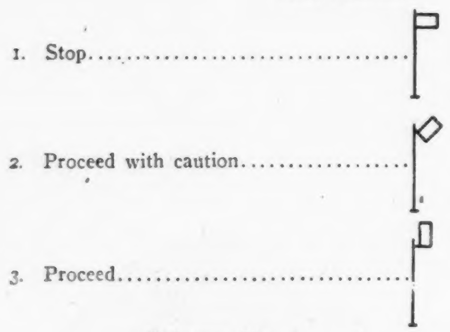
"Stop signals operated under automatic block system rules should be designated by some distinctive mark to be determined by each road in accordance with local requirements."

RECOMMENDATIONS.

The committee submits for approval the following two schemes of signaling in conformity with the recommendations of the committee on Transportation.

Scheme No. 1.

FUNDAMENTALS.



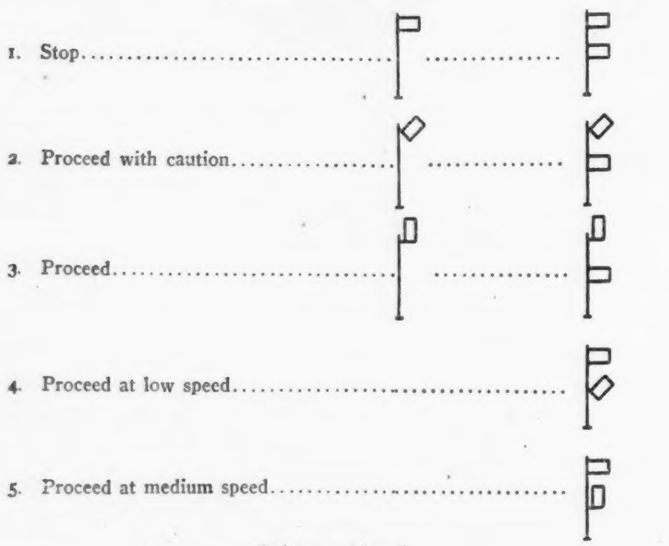
Scheme No. 1.

As means of designating stop signal operated under automatic block system rules, the following are suggested (for all three schemes):

1. The use of a number plate; or
2. The use of a red marker light below and to the left of the active light; or
3. The use of a pointed blade, the blades of other signals giving the stop indication having square ends; or
4. A combination of these distinguishing features.

Scheme No. 2.

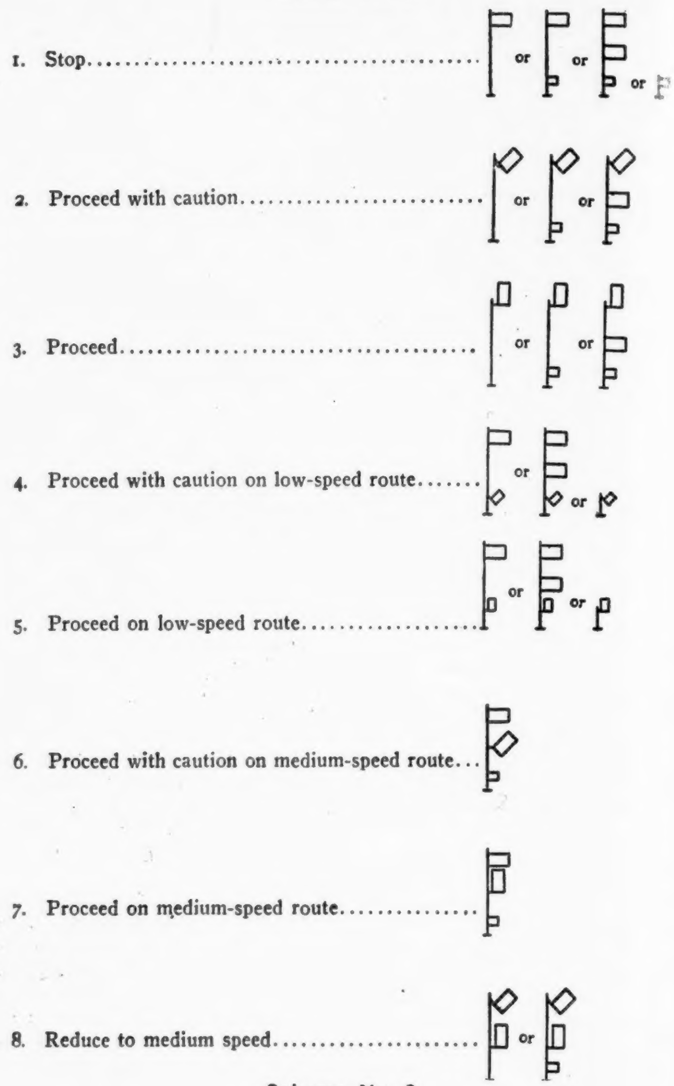
Fundamentals. Supplementary Indications.



Scheme No. 2.

Having in view the practice of indicating diverging routes by several arms on the same mast, the committee submits for approval the following to establish uniformity in this practice:

Scheme No. 3.



Scheme No. 3.

The above three schemes are submitted, after an earnest effort to carry out the instructions to "outline description of a comprehensive and uniform signal system, suitable for general adoption," with the idea that each scheme is complete in itself.

CONCLUSION.

That the signal indications and aspects and the means of designating stop signals operated under automatic block system rules, presented above, be adopted, published in the manual and referred to the American Railway Association as information.

EFFECT OF TREATED TIES ON TRACK CIRCUITS.

On Subject No. 2, "Report on the effect of treated and metal ties on track circuits," your committee submits the following report:

Historical.

In 1910 this committee was instructed to confer with the committee on Ties, and report on the effect of treated and metal ties on track circuits. Nothing was acomplished. (See page 128, Proceedings, Vol. 12, Part 1.)

In 1911 instructions were issued to report as above (omitting conference with commitee on Ties). Other subjects were given preference. (See page 70, Proceedings, Vol. 13.)

This is the third year, therefore, that the subject has been assigned to this committee.

Report.

The effect of metal ties is self-evident. Each rail must be completely insulated from its ties to prevent a short-circuit (similar to the action of the wheels and axle of a train). Defective insulation at any point will cause leakage and defective insulation at both ends of only one tie

will throw the track circuit out of service. The effect of creosoted ties is not serious and, with alternating current track circuits, is negligible.

The effect of zinc treated ties is more problematical.

In response to the circular sent to all members on June 1, 126 replies were received, representing 92 railroads—many of them trunk lines. Sixty-nine of these use no zinc-treated ties; four use them to such a limited extent as to render a report valueless, including two which are making the first installation this year; seven use them extensively, but not where track circuits are in service; twelve only use them with track circuits, showing that while the subject is decidedly important to these roads, it does not at the present time, in view of this small percentage, appear to be of great general interest; although, if it could be shown that this treatment did not affect circuits seriously, its use might be extended.

The following extracts from the reports of these twelve roads show that their experiences differ very considerably, due, doubtless, in some measure, to different methods of treatment, but mainly to varying conditions of track, road-bed and especially ballast:

(a) "We are obliged to cut or relay all of our track sections which exceed one-half mile in length, owing to the combined leakage due to treated ties, metal in our ballast and brine drippings. Therefore, none of our track circuits is more than one-half mile long, and with sections of this length we have no leakage trouble whatever, even on new lines where all of the ties are freshly treated. New zinc-treated ties undoubtedly increase the leakage at first, but the resistance seems to increase after they have been in service a year or so, and I do not think a 15 per cent. annual renewal would cause serious trouble on any track circuit of reasonable length if the conditions are fairly good otherwise.

(b) "Where track circuits were in operation and renewals were made of some 15 or 20 ties in one location, there was a considerably greater leakage or track circuit current than ordinarily. We had a number of intermittent working track sections. For some time we could not imagine what the trouble was; when finally we did discover it and improvements set in, in several cases the track circuits had to be shortened. It appears that in time the trouble diminished owing, as we believed, to the zinc treatment disappearing from the surface of the tie.

(c) "From our experience the influence of 15 per cent. new zinc-treated ties on a track circuit is not appreciable; where track circuits 4,000 ft. long have been installed on new second track completely equipped with zinc-treated ties, and where ballast and drainage conditions were good. On the other hand, we have found it necessary in some instances to take out zinc-treated ties and replace them with untreated ties where track circuit conditions were unusually bad, and the slight effect of zinc-treated ties was sufficient to overcome the safe operating margin. Such conditions, however, are extremely rare, occurring for the most part through station platforms where the rails are buried in material sometimes having relatively high conductivity.

(d) "A strange coincidence, however, was the fact that in those track circuits in which resistance seemed relatively low to the proportion of treated ties the ties were not uniformly spaced throughout the distance, but were bunched together at only a few points in each such track circuit. On the other hand, in other track circuits in which the resistance seemed relatively high in proportion to the number of treated ties the ties were spaced practically uniformly throughout the length of the track circuit. This would seem to indicate that the effect of a number of treated ties spaced closely is greater than their aggregate effect when spaced with several untreated ties between each two treated ones. In our investigation we also observed the electrolytic action first observed by V. I. Smart, of the Illinois Central, and reported in the *Railroad Gazette* of March 13, 1908. It was noted that the resistance between the two rails, while very low immediately after the installation of a number of treated ties, became appreciably greater after the ties had been in service a short time, due apparently to the insulation of spikes on the positive side of the circuit by the formation of chloride of iron crystals.

(e) "However, when they have been permitted to dry thoroughly before being placed, we have not had any bad effects. We find, if these ties are put in track immediately after treating, or while they are wet, we experience some trouble with leakage in our track circuits.

(f) "We afterward found that we could eliminate this trouble by letting the ties season, and I am quite sure if ties treated with chloride of zinc would be seasoned, you could put in more than 15 per cent. of them annually without interfering with the block signals. After the ties have been put in the track a sufficient length of time, even though they were not seasoned previously, the trouble will be eliminated. The experience on this road has been that where only a portion of the ties in a section are treated, it is necessary to use considerably more battery than where untreated ties are used, and I believe that if all the ties were zinc-treated, it would be very difficult to maintain a proper track circuit. The track circuit gets better as the ties get older, and in three or four years gets back to almost the same condition as if ties were untreated. In some cases where zinc-treated ties were used on this road, it was found necessary to reduce the length of track sections to 2,000 ft., and with these short sections we still experienced considerable trouble in damp weather. My general experience has been that it is a very hard matter to maintain a proper track circuit in sections where these zinc-treated ties were in use.

(g) "The peculiarity of this treatment is that it causes the most trouble on dry days, and apparently has very little, if any, effect on track circuits in cold or wet weather.

(h) "Where zinc-treated ties are used in all the renewals, and where from 8 to 15 per cent. of the ties are renewed per year, no appreciable effect is produced on the track circuits. In cases where zinc-treated ties are laid continuously, I have found that the length of track circuits would have to be reduced about one-half.

(i) "While we were using the zinc-treated ties we had one case where we had an automatic signal circuit about one mile long. It became necessary to renew a portion of the ties on this part of the track, and in renewing the new ties placed in the track are zinc-treated. The effect of the zinc was very noticeable, especially during wet periods. In fact, the ties caused short circuits so that the signals would not work. The result was that we took out the zinc-treated ties and placed cypress ties. I do not know what per cent. of the total number of ties were renewed, but it would appear that it was possible to ruin a circuit with a very few.

(j) "The ordinary yearly renewals of ties cause no trouble. However, I have experienced cases where on new track all of the ties being treated caused us a good deal of trouble for a period of two or three months. After this time, the leakage stopped, or at least there was not enough of it to prevent the track circuits working. My judgment is that where one is putting in track circuits on zinc-treated ties for new track, the track sections should be made somewhat shorter than otherwise would be necessary.

(k) "We have been using ties treated with chloride of zinc for the last four or five years, and our men advise that they cannot trace any track circuit trouble to the fact that the ties are treated with chloride of zinc. We renew about 15 to 16 per cent. annually.

(l) "With these treatments ('Burnettizing' and 'Card' systems) we find that no difficulty is experienced with track circuits of 3,500 ft. (our standard length), provided that no more than 15 per cent. of treated ties is introduced in one season.

(m) "We have not many zinc-treated ties in our automatic territory; that is, not enough in any one spot to cause very much trouble. We had some trouble with some that were put in last year during the wet season, but it seems that this spring the trouble has disappeared, as we have had no failures on account of wet track so far.

(n) "In some of our zinc-treated ties, which were put in track before being properly seasoned, there was, for a short time, some interference with the circuit, but as soon as the salt on the outside of the tie washed off the trouble ceased. At no time was this trouble serious.

(o) "We have track circuits where practically every tie is treated with this process and find no leakage at all.

(p) "In support of my contention that each tie is a battery, I wish to state that we obtained readings of .003 volt and eight mil-amperes on one of the track circuits, with the track battery and relay disconnected. In other words, the ties alone were producing this much electrical energy. The spikes also appear to have a somewhat shiny surface, such as we would expect from a battery electrode. We are able to pick out all treated ties by means of a voltmeter, by taking readings between one of the rails and a spike driven at random in the tie. On an untreated tie in the track circuit we merely get a slight deflection of the voltmeter needle.

(q) "We now have treated ties in on 19 track circuits

where treated ties are causing trouble. Ten of these circuits are new and nine are old circuits in which treated ties have recently been placed in renewals. Our record of signal failures shows that the trouble commences when the treated ties are put in. The trouble on the treated tie track circuits is due to a weak track circuit; i. e., with a sufficiently powerful track battery at one end of the circuit, the relay at the other end is not energized, due to insufficient current. This condition could be caused by too high resistance of the track circuit or by the track circuit becoming short circuited. The behavior of track batteries shows it is the latter which takes place, the battery being exhausted in five or six days, due to increased current generated. If the trouble were due to increased track circuit resistance, the battery would have longer life. As no change has been made in our track circuits during the last year, other than to put in zinc chloride-treated ties, we feel sure the trouble is caused by the treated ties, as our records now show a large increase in the failures. At a distant signal a year ago the track battery was made up once in every 18 days. One signal failure was reported during 1911. This spring 360 zinc chloride-treated ties were put in on the 5,000-ft. track circuit, and we now renew the track battery once every four days, and even this does not keep the signals working when it rains. At the circuit of another distant signal, 4,600 ft. long, 140 treated ties are causing the same trouble.

"In addition the treated ties are spoiling our track relays. With a variable current at the relay near the amount which causes the relay to pick up, there is considerable sparking at the points, which open and close continuously. This causes the platinum points to burn furrows in the carbon contact points above them. The west-bound distant signal stuck white with a train in the track circuit, August 12, due to platinum points on the relay being caught in the furrows they had burned in the carbon contacts above them. Each time it rains we have a number of failures, and the question should be studied to see what can be done to remedy the trouble. We tried, on one of the track circuits, oiling the ties inside the rail, thinking this might help, but it was not successful. Reports from other railroads show that the trouble disappears in time, but on this division the trouble is now on the increase."

Summary.

The consensus of opinion is:

(1) That track circuits a mile in length are rendered inoperative by the extensive use of zinc-treated ties.

(2) That track circuits 2,000 ft. in length may be operated successfully, even with 50 per cent. or more of ties so treated.

(3) That 10 per cent. to 15 per cent. renewals a year will not materially affect such length circuits.

(4) That, where renewals are made of 15 or 20 adjacent ties, the leakage is much greater than where there are made singly at uniform distances, i. e., with 15 per cent. renewals (every sixth or seventh tie).

(5) That, while the surface salts are present, more leakage occurs during wet weather than with untreated ties, as these wet salts form a better conductor than ordinary wet wood.

(6) That, in dry hot weather, the salts are drawn to the surface and constitute a more or less perfect conductor.

(7) That, after a period varying from three months to a year, these salts disappear and subsequently no interference is noticeable.

CONCLUSION.

That this report be received as information.

On Subject No. 3, "Economics in Labor of Signal Maintenance," your committee begs to state that this subject is being considered with reference to the report in 1914.

A. H. Rudd, chairman; L. R. Clausen, vice-chariman; Azel Ames, C. C. Anthony, H. Baker, H. S. Balliet, W. B. Causey, C. A. Christofferson, C. E. Denney, W. J. Eck, W. H. Elliott, M. H. Hovey, G. E. Ellis, A. S. Ingalls, J. C. Mock, F. P. Patenall, J. A. Peabody, W. B. Scott, A. G. Shaver, T. S. Stevens, H. H. Temple, Edwin F. Wendt, J. C. Young, committee.

Discussion on Signals and Interlocking.

Subjects No. 1 and 2 were unanimously approved. Subject No. 3 will be reported on next year.

IRON AND STEEL STRUCTURES.

The subjects assigned for investigation during the past year were:

(1) Report on rules for instruction and guidance of inspectors in mill, shop and field.

(2) Report on methods of protection of iron and steel structures against corrosion.

(3) Study the design of built-up columns, co-operating with other investigators and committees of other societies.

A final report on rules for instruction and guidance of inspectors in mill, shop and field, accompanied by a general descriptive statement of the qualities desired in an inspector, is given in Appendix A. Mr. Buel presents a minority report in Appendix B. Mr. Schneider desires that the report be referred back to the committee for further study.

A progress report on the design of built-up columns is given in Appendix C.

The recommendations of the committee may be summarized as follows:

(1) That the report on Rules for Instruction and Guidance of Inspectors in Mill, Shop and Field be adopted and printed in the manual.

(2) That the report of the sub-committee on the Design of Built-up Columns be received as a progress report.

A. J. Himes (N. Y. C. & St. L.), Chairman; J. A. Bohland (G. N.), A. W. Buel (W. M.), Charles Chandler (C. G. W.), C. L. Crandall (Cornell Univ.), J. E. Crawford (N. & W.), J. E. Greiner (B. & O.), W. H. Moore (N. Y., N. H. & H.), Albert Reichmann (Am. Br. Co.), O. E. Selby (C. C. C. & St. L.), vice-chairman; C. C. Schneider (Cons. Engr.), G. E. Tebbetts (K. C. Term.), L. F. Van Hagen (Univ. of Wis.), F. O. Dufour (Univ. of Ill.), C. E. Smith (M. P.), I. F. Stern (Cons. Engr.), F. E. Turneaure (Univ. of Wis.), committee.

A. J. HIMES,
Chairman Committee on Iron and Steel Structures.

APPENDIX A.

REPORT OF COMMITTEE ON RULES FOR THE INSTRUCTION AND GUIDANCE OF INSPECTORS IN MILL, SHOP AND FIELD WORK.

The duty of the inspector is to guard the interests of his employer. These interests include the safety of trains, persons and property; the quality of materials and workmanship; correctness of construction, and economy.

Some of the means at his command for protecting these interests are: The careful observance of such instructions as may be received from time to time; reports either received by him, as information concerning the status of the work at distant points, or prepared by him to exhibit the condition of the work under his immediate care; familiarity with the various means of communication between or among the several parties interested in the work and promptness in attending to messages and correspondence; and, by recording daily, in a journal kept for that purpose, the facts concerning all events that may affect the relations between his employer and the contractor, his employer and the public, the contractor and the

contractor and the public. The term "public" is intended to include all third parties. The purpose of such a record is to aid in the settlement of disputes and claims that may arise because of or grow out of the work in hand.

The inspector should have some knowledge of bridge stresses and should be able to read drawings quickly and with accuracy. A knowledge of elementary mechanics and of the mechanics of materials will enable him to understand the reasons for many specifications and the ultimate effect of faults of various kinds. Some knowledge of these branches of bridge building with which he is not directly concerned will be of advantage to him in understanding the work of inspectors employed upon such work. A knowledge of detailed designing is often a help in meeting emergencies or overcoming unexpected difficulties. He should have such knowledge of the relations between the employer and his employes as will enable him to assist in maintaining harmony in the working force.

Temperamentally he should be judicial and diplomatic and not controversial. He should be deliberate in his consideration of new or unexpected conditions, but prompt and decisive in action. When making investigations and reports he should be thorough and exhaustive, in order that the person using the reports may act thereon intelligently and correctly. An inspector's habits should be good, his honesty undoubted, and he should have a loyalty towards his employer that does not come from the payment of a salary. It is too much to expect that any one inspector will have all of these qualifications. His value will, however, be measured by the degree and extent to which he does possess them.

The inspector should be fully provided with the plans and specifications pertaining to the work. Often it is desirable that he should have masonry plans also in order that he may understand clearly the position which the structure is to occupy. He should have a copy of the contract or at least extracts therefrom covering those matters which might possibly need his attention. From time to time during the progress of the work he should be given special instructions covering its various phases. Should any further agreements or understandings be made or arrived at between the company which he represents and the contractor, he should be informed promptly concerning them.

Reports should be made at regular intervals defining the condition of the work and calling attention to matters of especial interest. Special reports should be made upon the happening of some event of more than ordinary interest. The amount of detail or the fulness of the regular reports should be governed by instructions. In general an inspector's time is more valuable when employed upon the site of the work where things are actually being done than in the office tabulating results. If a large amount of clerical work is required it is better to employ a clerk than to permit the inspector to perform duties which would keep him out of sight of the work which he is to inspect.

Instruction for the Mill Inspection of Structural Steel.

(1) Study the contract and specifications and secure such information concerning the proposed structure as will permit a full understanding of the use to be made of the various items of the order.

(2) Secure copies of the mill orders, shipping directions and other information concerning the material to be inspected.

(3) Attend promptly when notified of the rolling of material and so conduct the inspection and tests as not to interfere unnecessarily with the operations of the mill.

(4) Have the test specimens prepared and properly stamped with the melt numbers by the manufacturer. Observe the selection and stamping of specimens and verify the melt numbers when practicable.

(5) Attend and supervise the making of tensile, bending and drifting tests. Make sure that the testing machines are properly handled and that the specified speed of pulling is not exceeded. Note the behavior of the metal and check and record the results of the tests.

(6) Select the bars or other members for full-size tests as specified. Supervise such tests and check and record their results.

(7) Secure from the manufacturer records of the chemical analyses of the melts and accept only those in which the specified contents of impurities are not exceeded.

(8) Secure pieces of the test ingots and test specimens and have check analyses made outside of the manufacturers' laboratory when the analyses furnished by the manufacturer are erratic or for any other reason appear to be incorrect.

(9) Examine each piece of finished material for surface defects before shipment, requiring the material to be handled in a manner that will permit the examination to be thorough and complete. This inspection should detect evidence of excessive gagging or other injury due to cold straightening.

(10) Report promptly the shipment of any material from the mill, whose surface inspection has been waived. Such material should be examined by the shop inspector.

(11) Verify the section of all material by measurement and by weight.

(12) Study the operations of the plant and become familiar with the various processes of manufacture. Cultivate the acquaintance of the mill employes and become familiar with their work so as to have direct knowledge of the mill practice and determine as well as the circumstances permit the correctness of the mill practice in so far as it is covered by the specifications.

(13) Record all tests and analyses on the forms provided.

(14) Keep informed as to the progress of the work in the shop and endeavor to secure the shipment of material at such times and in such order as to avoid delay in the fabrication.

(15) Secure copies of the shipping lists, compare them with the orders and make regular statements of the material that has been rolled and shipped.

(16) Make reports weekly, or as may be directed, submitting complete reports of tests, analyses and shipments and such other information as may be required.

Instruction for the Inspection of the Fabrication of Steel Bridges.

(1) Acquire a full knowledge of the conditions of the contract, such as the time of delivery, the railway company's actual need of the work, the desired order of shipment, and any special features in connection with the delivery such as the position of the girders or truss members on cars at the bridge site.

(2) Study in advance the plans and specifications and see that all provisions thereof are complied with. These instructions are not to be construed as altering the specifications in any way.

(3) Endeavor to maintain pleasant relations with foremen and the workmen and by fairness, decisiveness and good sense interest them in the successful completion of the work.

(4) Attend constantly to the work, making inspection during the progress of the work in the shop, and striving to keep up with the output in order that errors may be corrected before the work leaves the shop. Conduct the inspection so as not to interfere unnecessarily with the routine operations of the shop.

(5) When unusual circumstances require an explanation of the plans or some variation from the specified procedure, take the necessary action promptly.

(6) Study the field connections, paying particular attention to clearances and making notations on the drawings so that they may be checked rapidly.

(7) Check all bevels and field rivet holes.

(8) Give careful attention to the quality of the workmanship, the condition of the plain material, accuracy of punching, care in assembling, alignment of rivets, tightness of rivets, accuracy of finishing of machined joints, painting and general finish.

(9) Make sure that reamed holes are truly cylindrical and that drillings are not allowed to remain between assembled parts.

(10) Watch for bends, kinks, and twists in the finished members and make certain that when leaving the shop they are in proper condition for erection.

(11) Make sure that the webs of girders do not project beyond the flange angles and that the depth of web below the flange angles complies with the specification.

(12) Allow only the material rolled and accepted for the work to be used therein.

(13) Have the fabricated material shipped in the correct order for erection and in accordance with instructions, as far as practicable.

(14) Measure the width of each column and the lengths of all girders between columns when they are to be placed consecutively in a long row so as to insure that the columns and girders will not "build out" in erection to exceed the calculated length.

(15 Check "rights" and "lefts" and make sure that the proper number of each is shipped.

(16) Check base plates of girders before riveting and make sure that the camber is not reversed.

(17) Check the space provided for driving field rivets, allowing sufficient space for the pneumatic riveter.

(18) Examine field connections after riveting to insure proper fitting and ease of erection.

(19) Make sure that shop splices are properly fitted and that matched and milled surfaces to transmit bearing are in close contact during riveting as specified.

(20) Examine and measure bored pinholes carefully to insure proper dimensions and spacing and smoothness of finish.

(21) Measure the spacing center to center of the end connections for sections of I-beam floors or any similar construction in which the calculated spacing is liable to be exceeded because of the tendency of such work to "grow" as it is assembled.

(22) Make sure that stringers connecting to floor beams beneath the flange have sufficient clearance to care for their possible over-run in depth.

(23) Have the assembling of trusses and girder spans required by the specifications carefully done and, in any case, if a large number of duplicate parts are to be made, insure the accuracy of field connections by having an occasional part assembled with its connecting member. The number of parts to be so assembled should be governed by the workmanship. If errors are found, a sufficient number of parts should be assembled to make it reasonably certain that such errors have been eliminated. Have at least one upper and lower shoe of each kind assembled and make sure that there is no interference.

(24) Make sure that iron templets used for reaming are properly set and held to line.

(25) Secure match-marking diagrams for work which has been assembled and reamed and make sure that the match marks are plainly visible.

(26) Have proper camber blocking used in assembling trusses and secure the desired camber before the reaming is done.

(27) Require that all treads and supports for the drums of draw spans be carefully leveled with an instrument.

(28) Study carefully the machine details and discriminate between those dimensions which must be exact and those in which slight variations are permissible. Determine in advance the desired accuracy of driving fits for bolts or keys and similar parts and make sure that such accuracy is attained.

(29) Examine castings carefully for blowholes and other imperfections and discriminate between such defects as are unimportant and those which render the castings unfit for use.

(30) Make sure that bushings, collars and similar parts are held securely in place.

(31) Make sure that all drum wheels, expansion rollers, turnable rollers and similar parts are exact in size, so as to carry equally the loads which may be placed upon them.

(32) Ascertain in advance that the paint provided complies with specifications. Watch carefully the painting directions and make sure that paint is properly applied and only where intended.

(33) Verify all shop marks and make sure that they are legible as well as correct.

(34) Have important members so loaded as to be headed in the right direction upon arrival at the site of the work.

(35) Try a few countersunk head bolts in the holes where they are to be used to insure a proper fit.

(36) Make sure that small pieces are bolted in place for shipment as shown on the plans and that other small parts are properly boxed or otherwise secured against loss.

(37) Make sure that rivets, tie rods, anchor bolts and miscellaneous parts are shipped so as to avoid delay in erection.

(38) Examine the field rivets to insure that they are free from fins or other defects.

(39) Exercise special care in the examination of all movable structures and particularly their moving parts.

(40) Make reports weekly, or as directed, exhibiting carefully and concisely the actual conditions.

(41) Observe carefully and report such unusual difficulties as may be encountered and the means adopted in overcoming them and endeavor by a study of the details or other means to make recommendations which will prevent their recurrence in future work.

Instructions for the Inspection of Bridge Erection.

(1) Study and observe the plans and specifications for steel construction. Study the masonry plans and check the masonry as built with the steel plans.

(2) Familiarize yourself with the local conditions affecting erection. Make the acquaintance of the principal men engaged upon the work and of local residents whose interests may be affected thereby.

(3) Obtain and study carefully the employes' time table and be well posted concerning the time when regular and extra trains are due and their relative importance. Acquaint yourself with all special traffic arrangements made because of the work in hand.

(4) Secure full information concerning the conditions of the work in the bridge shop and the probable dates of shipment.

(5) Obtain reports of any uncompleted or erroneous work that must be attended to after arrival of the material in the field.

(6) Study the erection program in order to avoid delays and be able to recommend some other procedure in an emergency.

(7) Endeavor to have full preparations made before disturbing the track so that the erection may proceed rapidly and the period of such disturbance be made a minimum.

(8) Keep a record of the arrival of all materials. The contractor's record should be sufficient if available. Strive to anticipate any shortage of material and use all available facilities to hasten delivery of the needed parts.

(9) Study the progress of the work and determine whether it is likely to be completed in the time allotted. If not, endeavor to secure such additions to the force and equipment as will insure such completion.

(10) Make a daily record of the force employed and the distribution of labor, in a way that will assist in following clauses 9 and 23.

(11) Exercise a constant supervision of any temporary structure or falsework and make soundings if necessary with the purpose of discovering any evidence of failure or lack of safety and having it corrected before damage is done. Examine erection equipment with a view to its safety and adequacy.

(12) Be constantly on hand when work is in progress and note any damage to the metal, failure to conform to the specifications, or any especial difficulty in assembling.

(13) Make sure that each member of the structure is placed in its proper position. If match marks are used, examine them with care. Endeavor to have the several members assembled in such order that no unsatisfactory makeshifts need be resorted to in getting some minor member in place.

(14) Prevent any abuse or rough usage of the material. Bending, straining and heavy pounding with sledges are included in such abuse.

(15) Watch carefully the use of fillers, washers and threaded members to see that they are neither omitted nor misused.

(16) Make certain that all parts of the structure are properly aligned and that the required camber exists before riveting. It is possible for a structure to be badly distorted although the rivet holes are well filled with bolts.

(17) Watch the heating of rivets to insure against overheating and to make sure that scale is removed. Examine and test carefully all field-driven rivets and have any that are loose or imperfect replaced. Have cut out and replaced all rivets, whether shop-driven or field-driven, that may be loosened during erection and riveting. Prevent injury to metal while removing rivets.

(18) Present to the contractor at once for his attention any violation of the specifications or contract, and secure a correction or refer the matter to the proper authorities as soon as possible.

(19) Keep informed concerning the use of company material and work trains and assist in procuring such material and trains when needed, and preserve a record thereof.

(20) Secure a match-marking diagram of any old structure to be removed and see that each part of such structure is properly marked in accordance therewith. Make a record of the manner of cutting the old structure apart and report any damage to the members of the old structure. Indicate by sketches or otherwise such repairs or replacements as will be found necessary in re-erection.

(21) Secure photographic records of progress and the important features of the work wherever practicable.

(22) Make a record of all flagging of trains, whether performed for the benefit of the contractor or otherwise, delays to trains, personal injuries, and accidents of every kind.

(23) Make reports as directed, showing the progress of the work, the size of the force and the equipment in use. Make a final report showing the cost of labor of erection per ton of material erected, the cost of labor per rivet in riveting, the cost of correcting errors in design and fabrication and commenting on the design and details; and give such other information as may be useful in planning similar work.

APPENDIX B.

MINORITY REPORT.

At the Buffalo meeting of the committee on September 9, the writer suggested that an effort be made to outline some method or system which would promise some improvement over existing mill and shop inspection, and that a co-operative railroad bureau, combining the good features of "company inspection" with those of "bureau inspection," deserves consideration, particularly on account of the very great advantages which the consolidation of a great tonnage would give, permitting the subdivision and specialization of work to a high degree under competent and experienced resident or district engineers and managers. The chairman of the committee seemed to think that our instructions from the Board to "report on rules for instruction and guidance of inspectors in mill, shop and field," were not broad enough to include anything along the lines of this proposal and the matter was dropped.

Within the past five years the writer had occasion to do personally a considerable amount of shop inspection, and was impressed with the change in conditions and shop practice that had occurred within a comparatively few years. Certainly he had all along an "appreciation" of these new conditions, but that is quite a different thing from the actual, detailed experience of working with them. This recent experience is the basis of the suggestion offered above.

Company inspection is sometimes better, but often worse, than bureau inspection, and even with all the work for a system of allied lines does not consolidate sufficient tonnage to permit such an organization with division of work and specialization as the writer has in mind.

The rules of instruction as drawn may be applicable to "company inspection," but it is not clear how they are going to be applied to bureau inspection, which represents the greater tonnage. They would be entirely inadequate for such a co-operative railway bureau as suggested above. It is the writer's opinion that they will only be useful for company inspection, and that even for this kind they should contain more detail of technical and practical kinds.

The ideas I have suggested with the purpose of improving shop and mill inspection may be expressed as follows:

First.—That the shop and mill inspection of structural steel, to be efficient and satisfactory, should be done on a scale large enough to economically permit the employment at each shop or mill of a corps of men, who may be called checkers, each one of whom is specially fitted and trained for a certain part or detail of the work under a resident inspecting engineer, thoroughly familiar with all details of structural steel and its fabrication, competent to direct the corps of checkers and decide questions calling for the judgment of a man of experience and structural engineering training. Resident inspecting engineers should report to the district chief inspector or manager, who should be an expert in structural steel and its fabrication, as well as a competent bridge engineer, and he in turn should report to the executive head of what may be called the American Railway Inspection Association; except that on technical matters and with proper regulations, he may report to and receive instructions from the chief engineers and bridge engineers of the railway companies which are members of the association.

Second.—That the American Railway Engineering Association use its influence to induce the railway companies to delegate officials to meet and discuss ways and means and, if it appears practicable, to provide for establishing the American Railway Inspection Association as an organization to make a highly improved and standardized shop and mill inspection of structural steel, furnishing the same at cost to the railway companies which are members of or supporting such association. As this can hardly become effective without the support of railway companies representing about 75 per cent of the annual railway purchases of structural steel, it would seem advisable to have the official delegates empowered, under proper restrictions, to pledge the adherence of their respective companies to the support of the project.

Later on such an organization could be expanded to include the inspection of steel rails, but as this would require practically a separate corps—only the district chief and his office and probably a chemist, being common to the inspection of both structural and rail steel—it will no doubt be considered advisable to defer this question to a future time.

The size of each shop corps should include about one man for each 10,000 tons' annual capacity of the shop; the number of independent inspectors at present employed is probably equal to or greater than that. This would require that the inspection of about 50 per cent of the shop capacity be done by the proposed organization, otherwise the cost of inspection would be greatly increased, and my object is to try to show that a very superior inspection method can be devised without greatly increasing the cost.

The district chief, or manager, ought to be a man worth at least $200 to $300 per month, depending on the importance of the district, and could cover a radius of, say, 100 miles from Pittsburgh, Chicago, Philadelphia or Cleveland. Each resident inspecting engineer should be worth not less than $200 or $250 per month at the larger shops, down to a minimum of, say, $150 at the smaller shops. The wages of the other men in a shop corps would range from about $1.00 per day for the scale boy to $4.00 per day for the men checking field fits, templets and laying out. This will work out to between 40 cents and 50 cents per ton for shop inspection in average shops down to 30 cents per ton in the largest shops.

The following is a tentative outline of a shop inspection corps and an estimate of cost for a shop of 100,000 tons capacity per annum, in one unit. For shops of two units a somewhat different arrangement would be required, and in each case the organization of the corps will have to be adjusted to the plan and character of the particular shop concerned:

District chief or manager	$3,600	
District chief, office expense	3,600	
District chief, expense account	1,200	
	$8,400	
25 per cent of $8,400		$2,100
Resident inspecting engineer	$3,000	
Templet checkers, 300 days @ $4	1,200	
Layout and punching checker, 300 days @ $4	1,200	
Assembling and fitting checker, 300 days @ $3	900	
Reaming and rivet checker, 300 days @ $2	600	
Machine and finished work checker, 300 days @ $3	900	
Field connection checker, 300 days @ $4	1,200	
Painting and yard work checker, 300 days @ $3	900	
Scale and weight boy, 300 days @ $1	300	
Clerk, 300 days @ $3	900	
		11,100
		$13,200
Add 15 per cent for general expense		1,980
Total		$15,180
50 per cent of 100,000 tons shop capacity—50,000 tons; 50,000 tons @ 30 36|100c.		$15,180

There would, of course, have to be a general office to which the district chiefs or managers would report, but on technical matters I think the district chiefs or managers should report directly to and receive instructions from the chief engineer or bridge engineer of the railway companies, subject to proper regulations where extra expense is involved.

While it is practically impossible to secure individual inspectors with all the qualifications recommended in the report of committee 15, the desired combination of attributes may be closely approximated in such an organization as that outlined above.

A. W. BUEL.

APPENDIX C.

STUDY OF BUILT-UP COLUMN.

The chairman got into touch with the chairman and secretary of the American Society of Civil Engineers' committee on Columns and Struts and ascertained the nature of the work being carried out under the direction of that

committee so that no duplication of such work would be made.

The chairman then took up with S. W. Stratton, director of the Bureau of Standards, Washington, the question of the possibility of having several series of column tests made by the Bureau in its new 2,300,000-lb. Emery machine then being installed. Director Stratton kindly agreed to have such series made and to begin the tests as soon as the machine was in commission. The sub-committee decided to make detail drawings for a preliminary series consisting of eight sections commonly found in the compression members and struts. A light and a heavy section of each type is to be made up in lengths giving three l/r ratios (50, 85 and 120) and three specimens of each column are to be fabricated, making in all 144 test columns.

The detail drawings were made up by J. E. Crawford and presented to the general committee for discussion at its meeting in Buffalo on Sept. 9, 1912. Ten members having expressed their satisfaction with this preliminary series, with some minor modifications, the chairman arranged with Director Stratton and J. E. Howard to have the 18 columns representing column No. 1, series No. 1, at once fabricated and the tests commenced as soon as the final adjustments of the weighing apparatus were complete. It is hoped that the tests will be under way before Jan. 1, 1913. Before ordering the fabrication of the remaining columns of series No. 1, the committee will examine the results of the first 18 tests representing column No. 1 and will probably then proceed with a sub-series on this column, changing one variable at a time in order to determine the best arrangement of details for the section. After the results of these tests are studied, the testing of the remaining columns of series No. 1 will be proceeded with, making such modifications as may be suggested by the results of the tests of column No. 1.

Discussion on Iron and Steel Structures.

A. J. Himes, chairman: The subject of third rail clearance was referred to the committee by the secretary on October 24, 1912, and is still under consideration. There seems to be a general agreement that a change in the diagram should be made. The matter is to receive further study by a sub-committee which will investigate the dimensions of equipment passing over the railroads and propose a new diagram.

At a joint meeting an extended discussion was held and provisions made for a joint committee consisting of two members from Committee XV of the American Railway Engineering Association, two members from the Railway Signal Association and two members from Committee X of the American Railway Engineering Association, provided that Committee X shall elect to co-operate in the work. The following gentlemen were chosen as members of the joint committee: Mr. Chappell, chairman, and Mr. Johnson, of the Railway Signal Association, and Mr. Smith and Mr. Selby of the American Railway Engineering Association.

The committee recommends to the Association that the following subjects should be investigated during the ensuing year:

Methods of Protection of Iron and Steel Structures against corrosion. Design of Built-up Columns. Secondary Stresses. Protection of Traffic at Movable Bridges. Revision of the Bridge Clearance Diagram. Standard Specification for Phosphor Bronze. Riveted Joints and Locomotive Turntables.

Rule 9 under Instructions for the Mill Inspection of Structural Steel was then read.

W. R. Edwards, (B. & O.): It seems to me questionable whether we should insert an instruction of this kind which is entirely contrary to the mill practice at the present day, and which it is impossible for the inspector to carry out.

Mr. Hines: The particular question raised by Mr. Edwards is cared for in Section 10, which says, "Report promptly the shipment of any material from the mill, whose surface inspection has been waived. Such material should be examined by the shop inspector."

A. W. Carpenter (N. Y. C. & H. R.); I will read an extract from a letter from our chief mill inspector which may be of interest:

"Owing to the inability of mill inspectors to examine the finished mill product at the mill and before shipment, but little mill inspection is now made along the lines as at first set out. In order to fully comply with this provision it would be necessary to have a number of inspectors at the mill day and night, and who under the present mill arrangement, will have to be stationed at the hot beds beyond the finishing rolls. The mills, if they were required to handle the product for service inspection, for instance at the loading wharfs, or sheds, have not usually provided any room or facilities for laying out and turning over of the structural material. (Rails they have provided for.) They would object strenuously to such an arrangement, and it would certainly make endless contention and confusion. As a stand off, in lieu of this, they have their own inspectors who look after the surfaces and throw out all defective material. The following inspector, accepting the material on test, they then ship forward, and if it is found to be defective on arrival at the shops where it is to be fabricated into the members intended, by the shop inspector, it is thrown out and ordered to be replaced."

The secretary then read "Instructions for the Inspection of the Fabrication of Steel Bridges."

Mr. Carpenter: What does "Camber is not reversed" mean in Rule 16?

O. E. Selby (C. C. C. & St. L.): There is a certain liability of riveting the base plates on the wrong side of the girder, and as some are designed the top flange is just like the bottom flange and they might be mixed up by careless shop work, and the bottom plate might be riveted on the top flange, instead of the bottom flange. I think that is what the clause means in referring to the camber.

T. Earle (Penn. Steel Co.): I would suggest in place of camber that the word "Bevel" be used, and then I think the clause will have a definite meaning. (The suggestion was accepted.)

Mr. Himes: The committee would be willing to make Rule 20 paragraph read: "Examine and measure bored pinholes carefully to insure proper position, dimension and spacing and smoothness of finish."

Mr. Earle: It seems to me it is hardly proper in instructions as Rule 23 to tell an inspector to do something that is not in the contract. It says, even if the contract does not call for the assembling, that the inspector shall require it. That seems hardly proper.

F. W. Wolffe (M. P.): The clause is decidedly objectionable, because it will invite the inspector to ask for an assembling and save himself the trouble of carefully measuring up the connections, which ought to be a part of his duty.

Mr. Cartlidge: I move that the committee be asked to consider this paragraph 23 further. I believe with Mr. Earle and Mr. Wolffe that this clause will cause difficulty. (The motion was carried.)

Mr. Carpenter: It seems to me there is a little redundancy in paragraph 28. Seems to me the driving pit is pretty nearly a definition of accuracy in itself. I would recommend omiting the word "driving."

The President: The committee will accept that.

Mr. Carpenter: There are a few additional clauses which seem to me might be added to this list of instructions that are not as important as most of those mentioned. One of them is to check the dimensions of the material used in each member. I see no reference to that. It seems to me that the fundamental thing is to see that the proper material goes into the members, and if there is anything that we want to call the attention of the shop to it is the checking of the material in the members to see that everything corresponds. I make a motion that we check the material in each member.

O. E. Selby, (C. C. C. & St. L.): Clause 8 seems to cover the question raised by Mr. Carpenter. "Care in assembling," is a somewhat general expression, but "proper attention to the assembling" would include checking the dimensions of the material assembled.

E. A. Frink, (S. A. L. Ry.): In rising to second Mr. Carpenter's motion I would like to say, I think the question of the size of the material is of importance. It is not at all unusual to have members of the same size of varying weights on the same struction. (The motion was carried.)

Mr. Carpenter: In section 20 under Inspection of Bridge Erection, it is not always desired to re-erect old structures. I would suggest after the word, "removed" we insert "which it is desired to re-erect."

The President: The committee will accept that.

Mr. Carpenter: It happens very frequently that a number of parts are bent in erection, especially lattice parts, and compression rivets, and I think a clause requiring the straightening of such parts, especially mentioning lattice parts, would be desirable.

Mr. Lindsay: There are no instructions requiring the inspector to look out for damaged new members, either in the unloading or the erection. I think another point to be guarded against in the unloading and storing of material is to prevent the accumulation of water on members.

The President: It is now in order to adopt these instructions as amended, for insertion in the Manual. Before putting the motion, however, the committee desires to omit

paragraph 23, under fabrication of steel bridges, and it will be taken up as one of the matters for future improvement. If there is no objection we will consider it as referred to the committee in the sense of re-writing it as an additional clause next year, but it will be entirely disregarded in this action of accepting the three sets of instructions for printing in the Manual. Those in favor of adopting these instructions for publication in the Manual, please signify by saying aye. (The motion was carried.)

TRACK.

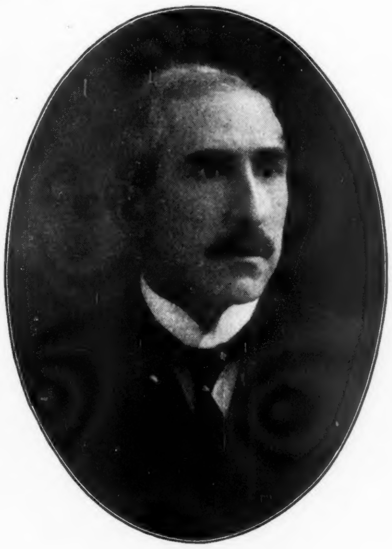
The committee presents statements of general principles to be followed in the design and manufacture of tie-plates, track bolts and anti-creepers and specifications for steel tie-plates, malleable tie-plates, wrought-iron tie-plates, track bolts, spiral spring nutlocks, ordinary track spikes and screw spikes.

TIE-PLATES.

General Principles to Be Followed in the Design.

The plates shall not be less than six inches in width, and as much wider as consistent with the class of ties to be used.

The length of the plates shall be not less than the safe bearing area of the ties divided by the width of the plate, and, when made for screw spikes, shall be so shaped as to provide proper support for the screw spikes.



J. B. JENKINS,
Chairman Committee on Track.

They shall be not less than 5/8 inch thick along either edge of the base of the rail.

The thickness of the plate shall be properly proportioned to the length.

The plates shall have a shoulder at least 1/2 inch high. The distance from the edge of rail base to the end of the tie-plate on the outer side must be uniform, and in excess of the projection inside of the rail base.

Where treated ties are used or where plates are for screw spikes, a flat bottom plate is preferable. Where ribs of any kind are used on base of plate, these shall be few in number and not to exceed 1/4 inch in depth.

The punching must correspond to the slotting in the splice bars, and, where advisable, may be so arranged that the plates may be used for joints. Spike holes may be punched for varying widths of rail base where the slotting will permit such punching without the holes interfering with each other and when the plate is of such design that the additional holes will not impair the strength of the plate.

SPECIFICATIONS FOR STEEL TIE-PLATES.

Material.

The plates shall be made of Bessemer or open-hearth steel.

Physical Properties and Tests.

The tie-plates shall conform to the following requirements:
Ultimate strength, not less than 55,000 lbs.
Elastic limit, not less than 50 per cent of ultimate strength.
Elongation, not less than 20 per cent in 2 inches.
Reduction of area, not less than 40 per cent.

Plates shall bend cold for 90 deg. without showing any sign of fracture.

A sufficient number of tests will be made to satisfy the inspector that the material meets the specifications in every respect.

Workmanship and Finish.

Subject to the following allowances, the form and dimensions of the plates shall conform to the drawings submitted to the manufacturer.

The length and width shall not vary more than 1/8 inch from the dimensions shown.

The thickness shall not vary more than 1/32 inch from the dimensions shown.

All variations in length shall be left on the inside end of the plate.

The distance from the shoulder to the outside end of the plate must be made uniform.

The spike holes must be punched from the top, clean cut, without burrs, and the plates must not be cracked or bent out of shape in punching the holes.

All plates must be stamped on the top side, outside of the base of rail, with the section and weight of rail.

The plates shall be free from burrs and imperfections.

Inspection.

When required, the manufacturer shall furnish samples of tie-plates from a preliminary rolling before proceeding with the filling of the order and give sufficient notice in advance of the date when they will be ready for inspection.

The inspector representing the purchaser shall have free entry at all times, while the work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered.

The inspection shall be made at the mill and the manufacturer shall afford the inspector free of cost all reasonable facilities to satisfy himself that the plates are being furnished in accordance with these specifications. The tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

Tests shall be made of samples of the finished product selected by the inspector from each lot of 50 bundles. Two pieces shall be selected for each test, and if both meet the requirements of the specifications the lot will be accepted. If one of the test pieces fails a third test piece shall be selected and tested; if it meets the requirements of the specifications the lot will be accepted, but if it fails the lot will be rejected.

If, after shipment, any tie-plates are found to be defective, due to material or manufacture, they may be rejected.

Shipping.

Tie-plates shall be wired together in bundles, the weight not to exceed 100 lbs., and shipped with a uniform number in each bundle.

SPECIFICATIONS FOR WROUGHT-IRON TIE-PLATES.

Material.

The plates shall be made of wrought-iron.

Physical Properties and Tests.

The ultimate strength shall be not less than 45,000 lbs.

Plates shall bend cold for 90 deg. without showing any sign of fracture.

A sufficient number of tests will be made to satisfy the inspector that the material meets the specifications in every respect.

Workmanship and Finish.

Subject to the following allowances, the form and dimensions of the plates shall conform to the drawings submitted to the manufacturer.

The length and width shall not vary more than 1/8 inch from the dimensions shown.

The thickness shall not vary more than 1/32 inch from the dimensions shown.

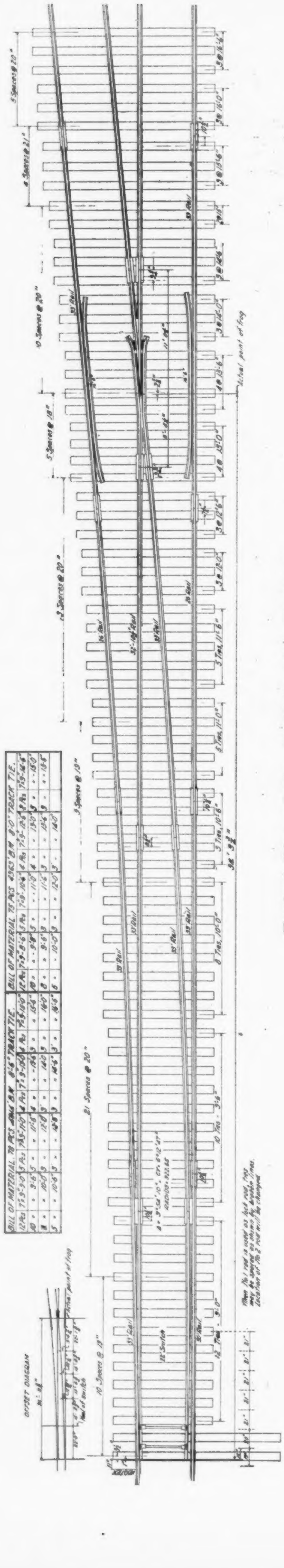
All variations in length shall be left on the inside end of the plate.

The distance from the shoulder to the outside end of the plate must be made uniform.

The spike holes must be punched from the top, clean cut, without burrs, and the plates must not be cracked or bent out of shape in punching the holes.

All plates must be stamped on the top side, outside of the base of rail, with the section and weight of rail.

The plates shall be free from burrs and imperfections.



Typical Plan of No. 11 Main Line Turnout.

Inspection.

When required, the manufacturer shall furnish samples of tie-plates from a preliminary rolling before proceeding with the filling of the order and give sufficient notice in advance of the date when they will be ready for inspection.

The inspector representing the purchaser shall have free entry at all times, while the work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered.

The inspection shall be made at the mill and the manufacturer shall afford the inspector free of cost all reasonable facilities to satisfy himself that the plates are being furnished in accordance with these specifications.

These tests and inspections shall be so conducted as not to interfere unnecessarily with the operation of the works.

Tests shall be made of samples of the finished product selected by the inspector from each lot of 50 bundles. Two pieces shall be selected for each test, and if both meet the requirements of the specifications, the lot will be accepted. If one of the test pieces fails a third test piece shall be selected and tested; if it meets the requirements of the specifications the lot will be accepted, but if it fails the lot will be rejected.

If, after shipment, any tie-plates are found to be defective, due to material or manufacture, they must be rejected.

Shipping.

Tie-plates shall be wired together in bundles, the weight not to exceed 100 lbs., and shipped with a uniform number in each bundle.

SPECIFICATIONS FOR MALLEABLE TIE-PLATES.

Material.

The plates shall be made from furnace malleable iron.

Physical Properties and Tests.

All plates must be cast with a lug for test purposes. The test lug when broken off must not break easily, as cast-iron, but must bend and show signs of toughness The fracture must show a narrow band of white metal on the surface, the center portion being dark and fiberless.

The plates must bend sufficiently to show thorough annealing.

A sufficient number of tests will be made to satisfy the inspector that the material meets the specifications in every respect.

Workmanship and Finish.

Subject to the following allowances, the form and dimensions of the plate shall conform to the drawings submitted to the manufacturer.

The length and width shall not vary more than 1-16 inch from the dimensions shown.

The thickness shall not vary more than 1-32 inch from the dimensions shown.

All plates must be properly and thoroughly annealed.

All plates must be well cleaned and free from warping, shrinkage, cracks, blow holes, fins, and other imperfections.

Inspection.

When required, the manufacturer shall furnish samples of tie-plates from a preliminary lot before proceeding with th filling of the order and give sufficient notice in advance of the date when they will be ready for inspection.

The inspector representing the purchaser shall have free entry at all times, while the work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered.

The inspection shall be made at the mill and the manufacturer shall afford the inspector free of cost all reasonable facilities to satisfy himself that the plates are being furnished in accordance with these specifications.

These tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

If, after shipment, any tie-plates are found to be defective, due to material or manufacture, they may be rejected.

Shipping.

Tie-plates shall be wired together in bundles, not to exceed 100 pounds, and shipped with a uniform number in each bundle.

TRACK BOLTS.

Facts and General Principles to Be Taken into Consideration in the Design.

As a rule, as large track bolts should be used as the rail and splice bars will permit.

Bolts with rolled threads show a greater ultimate strength than those of the same size with cut threads. The elastic limit, however, is not materially different.

A workman pulling on a 33-inch wrench with a pull of 100 pounds will load a ⅞-inch diameter bolt to the extent of 45,000 pounds per square inch, where the threads are in average condition. Therefore, it is easy to see how a bolt with a low elastic limit will readily be stretched in being tightened.

A ⅞-inch bolt with an elastic limit of 45,000 pounds will require the same pull to stretch it as a 1-inch bolt with an elastic limit of 35,000 pounds. Again, a 1-inch bolt with an elastic limit of 75,000 pounds requires over twice the pull to stretch it as a 1-inch bolt with an elastic limit of 35,000 pounds.

SPECIFICATIONS FOR TRACK BOLTS.

Material.

Steel shall be made by the open-hearth or other approved process. If necessary to secure the properties desired, the bolts may be heat treated.

Physical Properties and Tests.

The bolts shall conform to the following requirements:
For carbon steel
For untreated nickel or other alloy steel
For heat treated nickel or other alloy steel

Elastic limit	not less than	35,000 lbs. per sq. in.
Elastic limit,	" " "	25 per cent in 2 in.
Elastic limit,	" " "	50 per cent.
Elongation,	" " "	45,000 lbs. per sq. in.
Elongation,	" " "	20 per cent. in 2 in.
Elongation,	" " "	40 per cent.
Reduction of area,	" " "	75,000 lbs. per sq. in.
Reduction of area,	" " "	15 per cent in 2 in.
Reduction of area,	" " "	40 per cent.

Elastic limit shall in no case be less than 50 per cent of the ultimate strength.

The elastic limit, elongation and reduction of area may be determined on a test piece ½x2 in. turned from a finished bolt.

The ductility of the bolts shall be determined by the cold bend test, which requires that the material used in the bolts shall bend cold through 180 deg. and flatten itself without fracture on the outside of the bent portion. This bend may be made on the unthreaded portion of a finished bolt, on a blank bolt, or on a test piece of the same size and same grade of steel, in any case, subjected to the same treatment as the finished bolt. It is not necessary that the bolt bend double in the threaded portion.

A sufficient number of tests shall be made to satisfy the inspector that the material meets the specifications in every respect.

Workmanship and Finish.

Subject to the following allowances, track bolts shall conform to the drawings submitted to the manufacturer:

The length shall not be more than 1/16 inch less or ⅛ inch more than the dimensions shown.

The diameter of the bolt shall not vary more than 1-64 inch from the dimensions shown.

The size of the head shall not vary more than 1-16 inch from the dimensions shown.

The outside dimensions of the nut shall not vary more than 1-32 inch from the dimensions shown.

The shoulder of the bolt shall not vary more than 1-64 inch from the dimensions shown.

The heads and nuts shall be free from checks or burrs of any kind. They shall have the U. S. Standard upset thread unless otherwise specified. The threads may be either cut or rolled and shall be full and clean, with not less than two, or more than five, finger threads.

Inspection.

When required, the manufacturer shall furnish samples of bolts from a preliminary rolling before proceeding with the filling of the order and give sufficient notice in advance of the date when they will be ready for inspection.

The inspector representing the purchaser shall have free entry at all times, while the work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered.

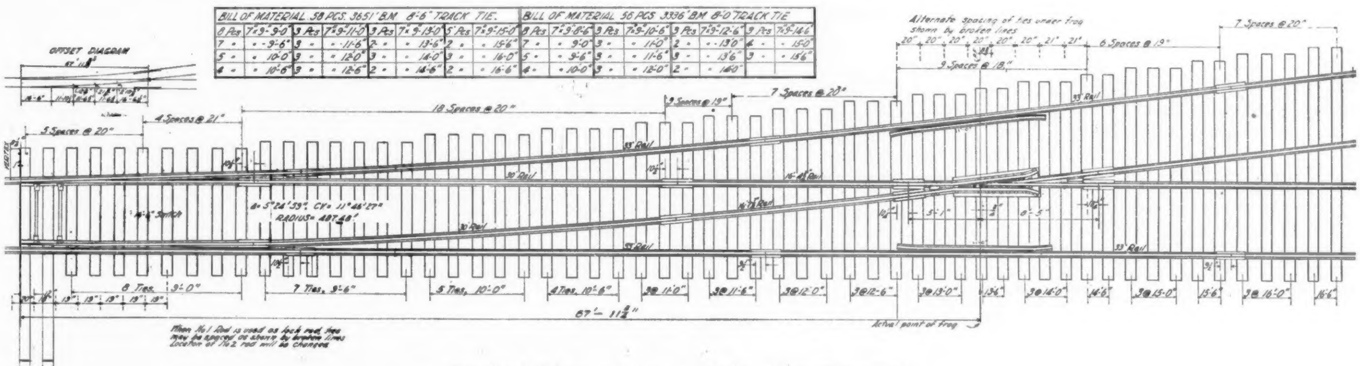
The inspection shall be made at the mill and the manufacturer shall afford the inspector free of cost all reasonable facilities to satisfy himself that the bolts are being furnished in accordance with these specifications. Tests and inspection shall be so conducted as not to interfere unnecessarily with the occupation of the works.

Tests shall be made of samples of the finished product selected by the inspector from each lot of 100 kegs. Two pieces shall be selected for each test and if both meet the requirements of the specifications the lot will be accepted. If one of the test pieces fails a third test piece shall be selected and tested; if it meets the requirements of the specifications the lot will be accepted, but if it fails the lot will be rejected.

If, after shipment, any bolts are found to be defective, due to material or manufacture, they may be rejected.

Marking and Shipping.

When the bolts are shipped they shall have the nuts applied for at least two threads, shall be properly oiled to prevent rusting and shall be packed in serviceable kegs. All kegs must be plainly marked as to material, size of bolts and name of manufacturer.



Typical Plan of No. 8 Main Line Turnout.

SPECIFICATIONS FOR SPIRAL SPRING NUTLOCKS.

Material.

The steel from which the nutlocks are made must be of open-hearth steel, or other approved process, and shall conform to the following chemical analysis:

Phosphorus, not over .05 per cent.
Sulphur " " .05 per cent.

Physical Properties and Tests.

After the finished nutlock has been subjected to pressure sufficient to compress it flat for a period of one hour, its reaction shall not be less than two-thirds its height or thickness of section, providing thickness is less than width of section. If the section is square, the reaction must not be less than one-half its thickness. If height or thickness of section is more than its width, reaction shall not be less than the width of the section.*

With one end of the finished nutlock secured in a vise, and the opposite end twisted to 45 degrees, there must be no sign of a fracture. When further twisted until

*Note.—The internal diameters naturally affect the percentage of reaction, and the above specifications apply to nutlocks of internal diameters from 13-16 in. to 1 5-16 in. Owing to the difficulty of establishing a common rate of percentage that shall be uniformly applicable to any internal diameter of any nutlock of any section, it has been sought to cover the matter as above. The amount and durability of the reactionary power under constant pressure is the true test of any spiral spring nutlock. The percentage of reaction increases proportionately with the increased internal diameter of any given section.

broken, the fracture must show a good quality of steel.

A sufficient number of tests will be made to satisfy the inspector that the material meets the specifications in every respect.

Workmanship and Finish.

The dimensions and form of the nutlock shall conform to the drawings submitted to the manufacturer.

The nutlocks shall be clean, without burrs or rough edges. The coil and cross-section shall be uniform throughout.

The manufacturer is required to guarantee:

First. That the steel was thoroughly annealed and permitted to assume its proper molecular structure before being made into nutlocks.

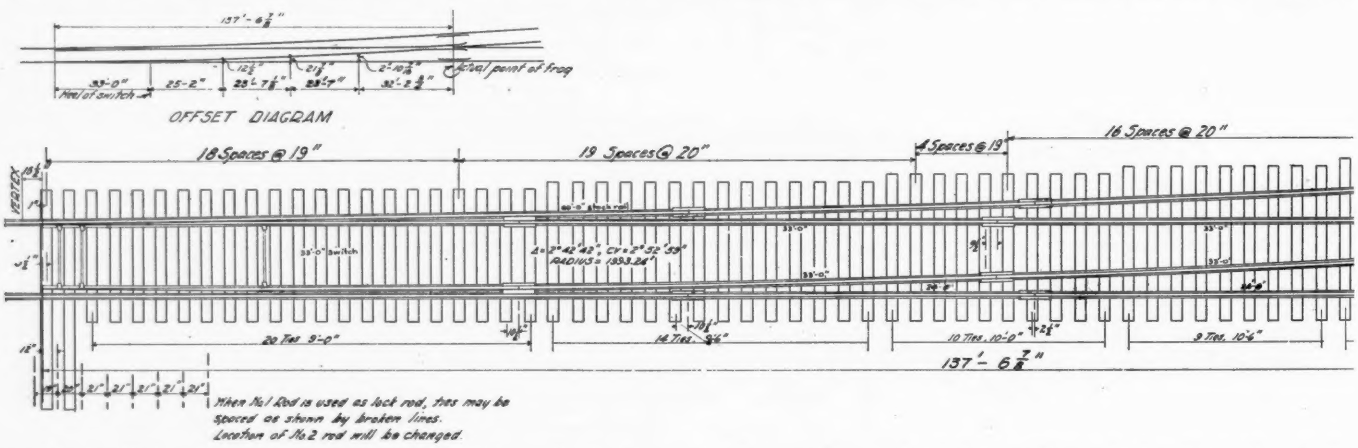
Second. That the subsequent heat treatment was scientifically accurate according to the best methods known, to secure uniformity of temper and the highest efficiency attainable.

Inspection.

When required, the manufacturer shall furnish samples of nutlocks from a preliminary lot before proceeding with the filling of the order, and give sufficient notice in advance of the date when they will be ready for inspection.

The inspector representing the purchaser shall have free entry at all times, while the work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered.

The inspection shall be made at the mill and the manufacturer shall afford the inspector free of cost all reasonable facilities to satisfy himself that the nutlocks are being furnished in accordance with these specifications. The tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.



Tests shall be made of samples of the finished product selected by the inspector from each separate heat treatment. Two pieces shall be selected for each test and if both meet the requirements of the specifications the lot will be accepted. If one of the test pieces fails a third test piece shall be selected and tested; if it meets the requirements of the specifications the lot will be accepted, but if it fails the lot will be rejected.

If, after shipment, any nutlocks are found to be defective, due to material or manufacture, they may be rejected.

Marking and Shipping.

When the nutlocks are shipped they shall be packed in good serviceable boxes. All boxes must be plainly marked as to material, size and number contained therein, and the name of the manufacturer.

SPECIFICATIONS FOR ORDINARY TRACK SPIKES.

Material.

Steel shall be made by the open-hearth or other approved process. If necessary to secure the properties desired the spikes may be heat treated.

Physical Properties and Tests.

The spikes shall conform to the following requirements:

Ultimate strength, not less than 55,000 pounds.

Elastic limit, not less than 50 per cent of ultimate strength.

Elongation, not less than 20 per cent in 2 inches.

Reduction of area, not less than 40 per cent.

The finished spike, when bent back on itself through 180 deg. and hammered down, shall show no signs of fracture.

When the head of the spike is bent backward cold it shall show no signs of fracture.

When the body of the spike is twisted cold 1½ turns it shall show no signs of fracture.

A sufficient number of tests will be made to satisfy the inspector that the material meets the specifications in every respect.

Workmanship and Finish.

Subject to the following allowances, the form and dimensions of the spike shall conform to the drawings submitted to the manufacturer.

The thickness shall not vary more than 1-32 inch from the dimensions shown.

The length shall not be less, nor over ¼ inch more, than the dimensions shown.

The thickness of the head shall not vary more than 1-16 inch from the dimensions shown.

The angle of the hook shall not vary more than one degree from that shown on the drawing.

The spikes must be neatly formed, free from burrs and rough edges, and have well-shaped heads and sharp points.

Inspection.

When required, the manufacturer shall furnish samples of spikes from a preliminary rolling before proceeding with the filling of the order and give sufficient notice in advance of the date when they will be ready for inspection.

The inspector representing the purchaser shall have free entry at all times, while the work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered.

The inspection shall be made at the mill and the manufacturer shall afford the inspector free of cost all reasonable facilities to satisfy himself that the spikes are being furnished in accordance with these specifications. The tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

Tests shall be made of samples of the finished product selected by the inspector from each lot of 100 kegs or bags. Two pieces shall be selected for each test and if both meet the requirements of the specifications the lot will be accepted. If one of the test pieces fails a third test piece shall be selected and tested; if it meets the requirements of the specifications the lot will be accepted, but if it fails the lot will be rejected.

If, after shipment, any spikes are found to be defective, due to material or manufacture, they may be rejected.

Marking and Shipping.

When the spikes are shipped they shall be packed in good serviceable kegs or bags. All kegs or bags must be plainly marked as to material, size of spikes and name of manufacturer.

SPECIFICATIONS FOR SCREW SPIKES.

Material.

Screw spikes shall be made of open-hearth steel.

The chemical properties of the finished spike shall conform to the following limits:

Phosphorus, not over .05 per cent.
Sulphur, " " .05 per cent.

Physical Properties and Tests.

The finished spike shall conform to the following requirements:

Ultimate strength, not less than 60,000 lbs. per sq. in.

Elastic limit, not less than 50 per cent of ultimate strength.

Elongation, not less than 22 per cent in 2 in.

Reduction of area, not less than 40 per cent.

The material used in the spikes when bent cold through an angle of 180 deg. and hammered down shall show no signs of fracture.

The finished spike when bent cold through an angle of 90 deg. shall show no signs of fracture.

A sufficient number of tests will be made to satisfy the inspector that the material meets the specifications in every respect.

Workmanship and Finish.

The dimensions and form of the screw spike shall conform to the drawings submitted to the manufacturer.

All spikes shall be finished smooth and in a workmanlike manner, having no rough edges. They shall be of exact size, with symmetrical heads the axis of which must be situated in the direct line of the shank axis produced.

Inspection.

When required, the manufacturer shall furnish samples of spikes from a preliminary rolling before proceeding with the filling of the order and give sufficient notice in advance of the date when they will be ready for inspection.

The inspector representing the purchaser shall have free entry at all times, while the work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered.

The inspection shall be made at the mill and the manufacturer shall afford the inspector free of cost all reasonable facilities to satisfy himself that the spikes are being furnished in accordance with these specifications. The tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

Tests shall be made of samples of the finished product selected by the inspector from each lot of 100 kegs or bags. Two pieces shall be selected for each test and if both meet the requirements of the specifications the lot will be accepted. If one of the test pieces fails a third test piece shall be selected and tested; if it meets the requirements of the specifications the lot will be accepted, but if it fails the lot will be rejected.

If, after shipment, any spikes are found to be defective, due to material or manufacture, they may be rejected.

Marking and Shipping.

When the spikes are shipped they shall be properly oiled to prevent rusting and shall be packed in good serviceable kegs or bags. All kegs or bags must be plainly marked as to material, size of spike and name of manufacturer.

ANTI-CREEPERS.

General Requirements to Be Met in the Design and Manufacture.

They shall be so designed as to fit two or more different weights of rail and so that they can be readily removed and reapplied.

They must be easy to apply under full-ballasted track.

They must be substantial enough to stand driving to place without chance of breaking.

The least possible number of movable parts is desirable.

When applied they must be in position rigidly enough to carry the tie with them in any kind of ballast without slipping.

They shall be made with sufficient take-up to permit of proper tightening.

They must not loosen when in place, or sufficiently to slip when the rail slacks back.

Controlling or delicate parts should be made of non-rustable material.

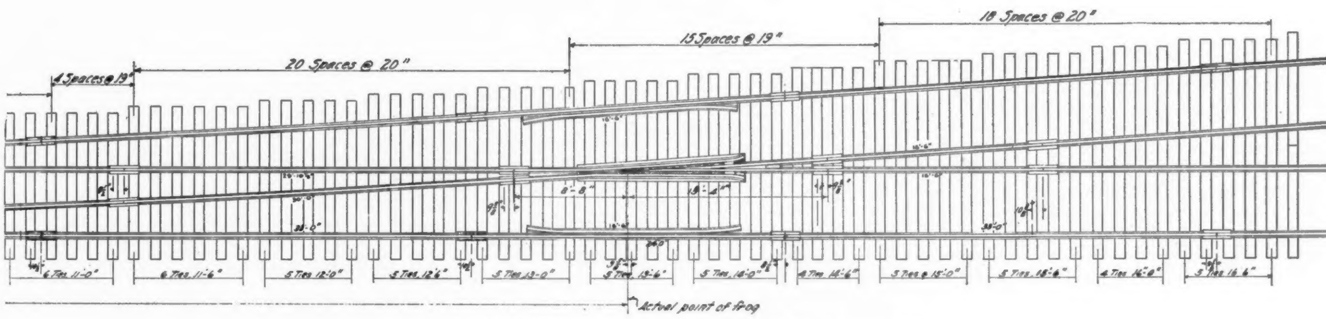
Anti-creepers made of steel shall be of sufficient size to minimize the destruction by rust.

Anti-creepers made of malleable iron must be from furnace malleable iron properly annealed, and of sufficient weight to prevent breakage and distortion in application or in service.

STUDY OF DESIGN OF MAIN LINE TURNOUTS.

The committee presents typical plans illustrating recommended designs for Nos. 8, 11 and 16 main line turnouts. In addition, it has secured data as to the height of center of gravity of locomotives and tenders recently constructed and has under way a table showing the speed at which trains may be run through various turnouts and various curves with different elevations of outer rail, for publication as a matter of information. This information is not yet in shape for submission. The committee has also begun the preparation of typical plans for cross-overs.

BILL OF MATERIAL. 115 PCS 7111 'B.M. 8'-6" TRACK TIE								BILL OF MATERIAL. 110 PCS. 6394 'B.M. 8'-0" TRACK TIE.							
20 Pcs	7"x9"-9'-0"	6 Pcs	7"x9"-11'-0"	5 Pcs	7"x9"-13'-0"	7 Pcs	7"x9"-15'-0"	20 Pcs	7"x9"-8'-6"	6 Pcs	7"x9"-10'-6"	5 Pcs	7"x9"-12'-6"	5 Pcs	7"x9"-14'-6"
14 "	" - 9'-6"	6 "	" 11'-6"	5 "	" - 13'-6"	5 "	" 15'-6"	14 "	" 9'-0"	6 "	" - 11'-0"	5 "	" 13'-0"	7 "	" 15'-0"
10 "	" 10'-0"	5 "	" 12'-0"	5 "	" 14'-0"	4 "	" 16'-0"	10 "	" 9'-6"	5 "	" 11'-6"	5 "	" 13'-6"	4 "	" 15'-6"
9 "	" 10'-6"	5 "	" 12'-6"	4 "	" 14'-6"	5 "	" 16'-6"	9 "	" 10'-0"	5 "	" 12'-0"	4 "	" 14'-0"		



Typical Plan of No. 16 Main Line Turnout.

ECONOMICS IN TRACK LABOR.

The committee adopted the following preliminary outline for future study, the plan being comprehensive and intended to cover the work of several years:

A system of reports to measure the efficiency of gangs for various kinds of work and the efficiency of various kinds of labor with a view to establishing tangible data to correctly measure efficiency.

A system of reports to establish unit costs of work.

The use of a system of work cards and other means of planning work and keeping records to measure progress.

The development of a plan and system for establishing a thoroughly accurate basis of comparison of track conditions as a means for measuring efficiency—equating for various conditions, such as rails, ballast, ties, drainage, length of track, etc.

A study of the use and efficiency of motor cars for track work.

A study of labor-saving devices.

A study of the method best suited to various kinds of track work, particular reference being made to rail, ballast and tie renewals.

A study of the method of renewing ties, as to renewal of ties on every mile of track each year or taking a portion of the track each year to avoid disturbing track too often.

A study of the matter of proper season for various kinds of track work.

A study of the organization best suited to carry on the above work as to extra gangs versus section gangs.

A study of the general suggestion to combine under section foremen such work as ordinary maintenance of signals and telegraph lines, rough carpentry, water station repairs, etc.

Proper size of track supervisors' territory.

The establishment of a labor bureau to better control and secure labor.

Training laborers for track work by specially organized gangs for that purpose.

Rates of pay for section labor.

The matter of obtaining good section foremen.

The education of section foremen.

The rates of pay of section foremen.

The proper basis for providing section houses.

The subjects chosen for immediate investigation were the matter of educating and securing section foremen and method of making program of work and sequence of work.

Two circulars were prepared and submitted to the membership dealing with these subjects. A great deal of information has been received, some of which enables the committee to reach a conclusion with reference to certain matters, and in other instances the information furnished is not in sufficient detail to enable a conclusion to be reached at this time, and these matters will be the subject of further research. Eighty-seven replies were received to this circular, and the following represents the summary of the information received:

"A" Has your company in effect any plan for the systematic education of men to fill the places of section foremen?

"C" Do you have any defined plan of equipping gangs with apprentices and assistant foremen?

Of the total replies received

57 indicated no plan in effect.

23 reported the practice of employing assistant foremen.

6 reported the practice of employing apprentices.

1 reported the use of a "school gang" for the education of foremen.

1 reported no information.

2 reported the practice of using both assistant foremen and apprentices.

"D" Do you have any defined plan of educating foremen as a class by instruction, such as educational bureaus, periodical meetings, etc.?

Of the replies received

72 indicated no definite plan for education.

10 reported the practice of periodically instructing men through meetings.

3 reported the use of educational bureaus.

1 reported education by pamphlet, and

1 reported education by inspection trips to other roads.

"B" From what classes of men do you now select foremen?

The intent of this question was to develop to what extent selections were made for foremen from certain nationalities or classes of labor, but the information received is quite general and not sufficiently specific to enable the sub-committee to give a very accurate opinion upon this matter, and this is to be made the subject of further research with a view to determining the relative efficiency of various classes or nationalities, information showing the number of each nationality employed, their qualifications as to honesty, reliability and general efficiency, and the effect, in employing foreigners for section foremen, in improving the supply of labor for ordinary section work with a view to overcoming the difficulties now existing in foreign labor desiring to work generally in large gangs.

"J" What percentage of your foremen are foreign born?

25 report none employed.

27 report 25 per cent or less.

16 report 50 per cent or less.

8 report 75 per cent or less.

7 report 100 per cent or less, and

4 give no information.

CONCLUSIONS.

The committee recommends for adoption and publication in the manual:

1. As representing good practice:

(a) Tie plates—General principles to be followed in the design.

(b) Specifications for steel tie plates.

(c) Specifications for wrought iron tie plates.

(d) Specifications for malleable tie plates.

(e) Track bolts—Facts and general principles to be taken into consideration in the design.

(f) Specifications for track bolts.

(g) Specifications for spiral spring nutlocks.

(h) Specifications for ordinary track spikes.

(i) Specifications for screw spikes.

(j) Anti-creepers—General requirements to be met in the design and manufacture.

2. As representing good practice:

Typical plans of Nos. 8, 11 and 16 main line turnouts.

3. As desirable agencies to obtain a better class of section foremen:

(a) The application of the principle of apprenticeship for a defined period during which the rate of pay shall be the same as a laborer, following which those men who show the necessary qualities for foremanship to be given an increase in compensation and the title of assistant foreman. From this position those men should be promoted to that of section foreman.

(b) The application of a method of education by periodical instruction in the form of meetings, at which supervising officers should instruct as to practice and encourage discussion between the men.

(c) The application where possible of an educational system, such as is being conducted on several of the larger railways, for which articles are written by supervising officers dealing with the best practices, which articles are printed and sent to foremen and assistant foremen free of cost, following which an examination is conducted and promotions depending on the results of such examinations.

4. The "Table of Functions of the Ten-chord Spiral" as supplementing and completing the table on pages 102-110 of the manual and superseding the table on page 111.

5. The headings "W = Length Theoretical Point to Toe" and "K = Length Theoretical Point of Heel" in place of "W = Length Point to Toe" and "K = Length Point to Heel" in columns II and III, Table of Theoretical and Practical Switch Leads on page 92 of the manual.

The committee recommends that subjects 2 and 3 be reassigned, the former with instructions as to the features to be studied.

J. B. Jenkins (B. & O.), chairman; G. J. Ray (D. L. & W.), vice-chairman; Geo. H. Bremner (C. B. & Q.), A. Bruner (N. & W.), Garrett Davis (C. R. I. & P.), Raffe Emerson (Cons. Engr.), E. G. Ericson (Pa. Lines), J. M. R. Fairbairn (C. P. R.), T. H. Hickey (M. C.), E. T. Howson (Railway Age Gazette), J. R. Leighty (M. P.), Thos. Maney (L. & N.), Curtiss Millard (C. G. W.), P. C. Newbegin (B. & A), R. M. Pearce (P. & L. E.), H. T. Porter (B. & L. E.), W. G. Raymond (Univ. of Iowa), S. S. Roberts (I. C.), L. S. Rose (C. C. C. & St. L.), H. R. Safford, (G. T.), C. H. Stein (C. R. R. of N. J.), F. S. Stevens (P. & R.), A. H. Stone (K. C. Term.), W. J. Towne (C. & N. W.), C. C. Wentworth (N. & W.), Committee.

Discussion on Track.

Conclusion No. 2 was adopted, the term "timber," replacing the word "material." Conclusions No. 3, 4 and 5 were also adopted.

Mr. Jenkins: I would move the adoption and publication in the Manual of Specification (a) in conclusion No. 1.

Mr. Stimson: I move the third paragraph specifying ⅝ in. thickness be stricken out and that it be considered that the thickness of the plate is covered by the next paragraph, and that there are comparatively few tie-plates now in use ⅝ in. thick. (The motion was seconded and carried.)

The Secretary read the paragraph beginning, "The spike holes must be punched——"

Mr. Jenkins: I wish to announce that the committee by letter ballot amended that specification so as to read, "The spike holes must be punched clean cut, without burrs, and the places must not be cracked or bent out of shape in punching the holes." The committee recognizes in the majority of cases it is best to punch the holes from the top, and that should be the general practice, but there are special cases where the holes should be punched from the bottom, where the punching cannot be successfully done from the top.

Mr. Lindsay: In connection with section relating to the stamping of plates, I think that would be improved if it read, "All plates must be stamped on the top side, outside of the rail seat, with the prescribed mark indicating the section and weight of the rail." I make that suggestion because on many roads we have our standard tie-plate which gives a distinct letter or number for the tie plate that is to be used with certain weights of rails. There are certain letters which are to be used for the tie-plate at the joint, and others at the end of the angle bar. I believe if it is made to read in the form I have suggested, it would be more universally applicable.

The President: The committee will accept that amended reading.

Mr. Lindsay: Under the heading "Shipping" at the end of the specifications for steel tie-plates, I would like to substitute the following: . . . "Tie-plates shall be wired to-

gether in bundles of uniform number, weighing not to exceed 100 lbs. and properly tagged."

Mr. Jenkins: The committee will accept that suggestion.

The President: A motion was made and seconded that the general principles to be followed in the design of tie plates, as amended be adopted for publication in the manual.

The motion was put to vote and carried.

Mr. Jenkins: I move the adoption for publication in the Manual of the Specifications for Steel Tie-Plates, as amended.

The motion was carried.

The secretary then read the Specifications for Wrought-Iron Tie-plates.

L. C. Fritch: I move that the specifications for wrought-iron tie-plates be amended to harmonize with the amendments in connection with the specifications for steel tie-plates, which are substantially the same as the specifications for wrought-iron tie-plates.

The motion was carried.

Mr. Lindsay: I suggest that the Specification for Malleable Tie-Plates be read, caption by caption.

Mr. Fritch: Under "Workmanship and Finish," it is stated that the length and width shall not vary more than 1/16 in. from the dimensions shown, while in the wrought iron and steel specifications it is given as ⅛ in. What is given as the difference?

Mr. Jenkins: The malleable tie-plates can be made to conform better to the dimensions than the steel tie-plates can.

Mr. Lindsay: I move that the shipping articles be changed to agree with the same article under steel tie-plates and wrought iron tie-plates.

The President: The committeee will agree to that.

Mr. Jenkins: I move that the specifications for malleable tie-plates be adopted. (The motion was carried.)

(The Secretary read the Facts and General Principles to Be Taken into Consideration in the Design of Track Bolts, which was adopted.)

The Secretary read the specifications for Track Bolts.

Mr. Lindsay: Under "Workmanship and Finish," I would like a clause somewhat as follows inserted: "Care must be taken to avoid damage to the metal by overheating in manufacture."

Mr. Jenkins: The committee will accept that.

Mr. Jenkins: I move that Specification for Track Bolts be adopted as amended for publication in the Manual. (The motion was carried.)

(The Secretary read the specifications for Spiral Spring Nut Locks, and they were adopted.)

The Specifications for Ordinary Track Spikes were then read.

The President: In connection with these specifications, it is understood that any changes made in the previous specifications that should be made in these specifications to make them harmonize with the others will be made in these specifications.

Mr. Fritch: I think somewhere in the specifications we should show how the length of the spikes should be measured, whether it should be the length over all, or the measurements should be under the head.

Mr. Jenkins: The committee will amend the paragraph just read by having it begin "The length under the head," etc.

The President: That will undoubtedly be acceptable.

Mr. Jenkins: I move the adoption, for publication in the Manual, of the Specifications for Ordinary Track Spikes. (The motion was carried.)

(The secretary read the specifications for screw spikes.)

Mr. Lindsay: Have the committee considered the method of making the thread on the screw spike, or do they think it necessary to specify how the thread should be formed?

G. J. Ray: There is only one way that the thread can be made economically, and that is rolled. When you buy them, you will find that the manufacturer who makes them in any other way will not be able to compete with the markets. I do not think there is any question but what the method of manufacture will take care of itself. You have to roll them to make them economically.

Mr. Lindsay: Many spikes are shipped in boxes. I think the paragraph should read "Good serviceable boxes, kegs, or bags."

Mr. Jenkins: The committee will change that by making it read "Shall be packed in good serviceable packages."

Mr. McDonald: Why was Bessemer steel cut out in connection with screw spikes as well as bolts, and retained in regard to tie plates.

Mr. Jenkins: We think a better quality of material is required in screw spikes and bolts than in tie plates.

Mr. Jenkins: I move the adoption and publication in the Manual of the Specifications for Screw Spikes. The motion was carried.

The secretary read the general requirements to be met in the design and manufacture of anti-creepers.

Mr. Lindsay: I think the clause should read: "They must not loosen when in place sufficiently to render the anti-creeper inoperative when the rail slacks back."

The President: The committee will accept that.

Mr. Jenkins: I move the adoption of the general requirements to be met in the design and manufacture of anti-creepers for publication in the Manual. (The motion was carried.)

E. F. Wendt (P. & L. E.): I want to make a few remarks on the question of "Economics in Track Labor," referred to in this report. A number of the committees have begun the study of economics. This work grows out of the paper of Mr. Loree submitted at the last convention, which showed that about 55 per cent of all of the expenses of a railroad consisted in the cost of labor. The object of our association is the advancement of knowledge pertaining to the scientific and economic maintenance of railways. I submit that we have done well to take up these scientific studies which relate to the economics, and the beginning of this work marks an epoch in the history of our association.

The relation of the cost of labor to the gross revenue of all the railroads in America has risen, as shown by the figures of the Interstate Commerce Commission. During the past 20 years wages to gross revenue have risen from 37.7 to 41.9 per cent. During the same period the ton mile rate, which represents the amount of money the railroad company receives from the public, has declined from 9.3 mills to 7.5 mills, and during the same period the relation of dividends and interest to gross has declined from 28.3 to 24.2 per cent. It is, therefore, apparent that every effort should be made to bring about such economies in labor as are possible.

In our railroad industry there are three interests entitled to a hearing, the capitalist, the wage earner, and the people who use the roads. To show how each of these three interested classes has fared for some time past, here are the percentages of total gross earnings devoted to wages and to interest and dividend payments. How the third party of the contract, the public, as typified by the shipper, has fared can be seen from the average rate per ton per mile:

	Per cent. Wages to Gross	Per cent. Dividends and Interest to Gross	Ton-Mile Rate
1911	41.90 per cent*	24.27 per cent*	0.750*
1910	40.43	23.47	0.753
1909	40.03	24.33	0.760
1907	40.47	20.99	0.759
1905	39.36	23.84	0.766
1903	38.82	24.47	0.763
1900	37.99	25.74	0.729
1895	40.78	30.17	0.840
1890	37.71	28.37	0.930

Since 1890 wages have risen 11.1 per cent, as compared with gross earnings, while dividend and interest payments taken together, notwithstanding the rise of recent years, show a net decline of 14.5 per cent. The general tendency has been to devote a decreasing portion of gross earnings to payments to the capitalist and an increasing portion to wages.

Mr. Lindsay: I ask the committee to study the question of cross-overs. It is a large subject that is in the air, and we are told the recommendations of this committee are all wrong, and that we must have a No. 20 cross-over, to be entirely safe, in order to operate a railroad safely. The committee has considered nothing longer than No. 16 as necessary, and one Public Service commission has gone on record as saying it is entirely safe to run at the normal speeds incident to every day operation through a No. 20 cross-over. I hope the committee in studying this question will give attention to the matter of curvature at the switch angle. I figured roughly with an engine of 17-ft. wheel base on a 15-ft. switch point, with a spread at the heel of 6 in., the curavture is equivalent to 22 deg. and 35 min.; with a 20-ft. switch point, it is 16 deg. and 15 min.; with a 30-ft. switch point, it is 13 deg. and 6 min. Assuming the rigid wheel base of a locomotive as including the distance from the forward pony truck to the rear driver, as 26 ft. with a 15-ft. switch point, the curvature is 14 deg. 34 min.; with a 20-ft. switch point, 10 deg. 55 min., and with a 30-ft. switch point, 8 deg. 30 min. Assuming the rigid wheel base as 34.66, with a 15-ft. switch point, the curvature would be 11 deg. 2 min.; with a 20-ft. switch point, the curvature would be 8 deg. 55 min.; with a 30-ft. switch point the curvature would be 6 deg. 37 min. How fast is it safe to go over the switch point regardless of the curvature of the point, and go by a switch point without any elevation at normal speed?

Mr. Jenkins: The committee has gone ahead with its work

*Estimated.

and has prepared designs for cross-overs which it will submit next year, and the committee has also undertaken to find out the relation of speed to turn-out radius, and the relation of speed to the switch angle, and we have made some progress along that line.

RAIL.

The work outlined by the board of direction for the year was as follows:

(1) Consider revision of the manual; if no changes are recommended, make statement accordingly.

(2) Present recommendations on standard rail sections.

(3) Continue investigation of rail failures and present conclusions drawn therefrom.

(4) Continue special investigation of rails.

(5) Make concise recommendations for next year's work.

REVISION OF MANUAL.

The work of the committee resulted, after several years, in the presentation of a set of specifications for carbon steel rails at the annual convention in 1912, which was adopted by the association.

Since that time, some criticisms of the clearness of the meaning of one or two of the sections have been received, and the committee has made a careful study of all the sections in the specifications, with a view to keeping them up to date and making them as perfect as possible, with the result that a few revisions are now submitted for adoption by the association, some of them being merely changes in wording and rearrangement, which it is hardly necessary to point out in detail. The principal changes are, however, as follows:

W. C. CUSHING,
Chairman Committee on Rail.

Section 4. *Chemical composition:* The words "of each heat" have been added, so that the section reads, "The chemical composition of each heat of the steel from which rails are rolled, determined as prescribed in section 7, shall be within the following limits."

This change was made because the question arose at one mill as to whether it was necessary for every heat to have its chemical elements within the limits prescribed by the specifications.

Section 14. *Elongation or ductility:* A new paragraph has been added, as follows: "A sufficient number of blows shall be given to determine the complete elongation of the test piece of at least every fifth heat of Bessemer steel, and of one out of every three test pieces of a heat of open-hearth steel."

In measuring the elongation, acceptance or rejection is determined by the amount shown under one or more blows of the tup, but in addition to this, it is advisable to determine the total elongation or ductility of a certain number of test pieces, in order to keep informed on the toughness of the material, by repeating the blows till failure results. It is at present customary to carry on these tests, and it was thought advisable and proper to add the requirement to the specifications in order to make them more complete.

Section 17. *Bessemer process drop tests, clause* (*b*): The words "does not break and" have been added to the second line, so that the clause reads, "If the test piece breaks at the first blow or does not show the required elongation (section 14), or if the test piece does not break and shows the required elongation, but when broken shows interior defect, all of the top rails from that heat shall be rejected." The words "nicked and" have also been omitted from both clauses (a) and (b). Both the additions and omissions were brought about by discussion as to the precise meaning of the clause. Similar changes have been made in (c), (d), (e) and (f).

Section 18. *Open-hearth process drop tests:* Clauses (a) and (b) have been made to read as follows:

(a) "If two of these test pieces do not break at the first blow, and if both show the required elongation (section 14), all of the rails of the heat shall be accepted, provided that none of the three test pieces when broken show interior defect."

(b) "If two of the test pieces break at the first blow, or do not show the required elongation (section 14), or if any of the three test pieces when broken show interior defect, all of the top rails from that heat shall be rejected."

In clause (a), the changes were the addition of the words "if both," the addition of the words "none of the three," and the omission of the words "nicked and," also "do not."

In clause (b), the additions were the words "three tests" and the omission of the words "that have been tested under the drop" and "nicked and."

The changes were made necessary to abolish any cause for dispute as to the meaning, because, as already explained for section 17 (a) and (b), some were inclined to lay too much stress on the words "nicked and" when considering the rejection of certain rails represented by the test piece which showed interior defect, although it had not been nicked. Similar changes have been made in clauses (c), (d), (e) and (f), for the same reasons.

Section 30. *Straightening:* A new clause (b) has been added as follows: "Rails heard to snap or check while being straightened shall be at once rejected."

It is well known that the present method of straightening rails is undesirable, but it is the one almost universally employed and no other method now known is considered practicable. Sometimes, during this straightening process, rails are heard to snap, indicating that some unusual injury has been done, and it is the object of this clause to make that grounds for rejection.

Section 32. *Finishing:* A new clause (c) has been added, as follows: "When any finished rail shows interior defects at either end or in a drilled hole, the entire rail shall be rejected."

The rejection of such rails at the mills has been a source of dispute for several years, and in order to remove the cause for further contention, this clause has been added.

(*b*) *Revision of rail record forms.* "*Report of Mill Inspection, Form M. W.* 401." On page 59 of the manual is shown the present standard form of the association, entitled "Report of Chemical and Physical Examination," but since the change in the rail specifications, it is no longer suitable for the purpose, because, in the case of open-hearth heats, three ingots of each heat are tested instead of one, and an elongation or ductility requirement has been added; consequently, it is necessary to have a form on which the additional results can be reported. The name has been changed to "Report of Mill Inspection," because of the similarity of the form name to that of M. W. 407, "Laboratory Report of Chemical and Physical Examination." A new form, to take the place of the old one, is therefore submitted.

"*Certificate of Inspection, Form M. W.* 402." In connection with the new specifications adopted by the association, it has become advisable to make changes in the above form, now printed on page 60 of the manual, and therefore a revised form is submitted. The principal change is the tabulation in two columns of the "Rails Accepted" and the different causes for "Rails Rejected."

"*Laboratory Report of Chemical and Physical Examination of Rail, Form M. W.* 407." The present standard form is illustrated on page 67 of the manual, but, owing to progress in testing, which has resulted in the addition of tests, it has been found advisable to provide for the report of those additional tests; consequently, this form has been entirely revised, and a new blank is presented. The old form provided only for chemical analyses and the usual physical tests of tensile strength, elastic limit, elongation and reduction of area, while the new form provides for the report, in addition, of the drop test, hardness test, and transverse test of base.

"*Tabulation of Results of Mill Inspection of Rails, Form M. W.* 418." Owing to the change in the rail specifications, it will be necessary to revise this form, which is now illustrated between pages 60 and 61 of the manual. A new form, with the necessary additions in columns for entering the observed data, is submitted to you for your approval.

STANDARD RAIL SECTIONS.

The American Railway Association delegated to the Rail Committee of the American Railway Engineering Association the question of sections of rail and other matters connected with them, as well as that of specifications.

The sections used by the various railroads were collected, comparison between them and sections suggested by members of the committee was made, and all of the information as to rail failures in connection with the sections which could be obtained was considered. Some members of the committee submitted sections for consideration where their studies suggested that changes might be made for a better section, the desire being to keep the section within certain lines so that rail joints could be used and have a bearing on the straight portion of the rail both under the head and on top of the base, with as little additional stress on the bolts as possible.

At the meeting of the sub-committee in Pittsburgh it was decided that, while there was some merit in the suggested sections, the committee is not in a position to recommend any new section at the present time, as the sections of the so-called A.R.A. types "A" and "B" had been used by a number of roads, with good results as compared with other sections, but they have only been in use for about three years at the most, and with a great many roads only about two years. It is the consensus of opinion of the sub-committee that it may be advisable to add a little metal to the fillets both under the head and at the base.

The sub-committee, however, has under consideration modified sections, and will continue to study from time to time as it obtains information concerning the weak spots in the present sections. It will also undertake to make a study of rail joints and report at future meetings.

In regard to rail stresses; there is a great deal of indefiniteness regarding the methods by which various parties have estimated them. P. M. La Bach, of the Rock Island Lines, has worked on this problem, and the results have been sent out in sections to the members of the Rail committee. He is now revising the information, and putting it in better shape. The committee will also have other data that it will use in connection with the above, and it may be necessary for some members of the association to make experiments of their own.

The subject of "Stresses to Which Rails Are Subjected in Service" has been under preliminary investigation for the past year by Sub-Committee "D," Mr. Baldwin, chairman.

STATISTICS OF RAIL FAILURES.

The statistics of rail failures for the year ending October 31, 1911, were prepared by Mr. Trimble. The responses have been more complete than ever before, and the information furnished relates to 12,893,007 tons of rail. The report contains a great deal of valuable and useful information, nevertheless, it is proper to call the attention of the members to the fact that it is impossible to make comparisons under similar conditions of traffic, roadbed and weight of rail when dealing with the reports from companies whose problems vary widely, and because it is not feasible to obtain the information which would be necessary to make comparisons accurate, such, for instance, as the tonnage which has passed over rail of equal age and with the same quality of roadbed. The record of comparative wear of special rail, however, is being kept in such a way that comparisons are possible.

SPECIAL INVESTIGATION OF RAILS.

Experiments and Tests.

M. H. Wickhorst, engineer of tests for the committee, has continued his work on experiments and tests under the direction of sub-committee "A" during the past year, and the results of his work are issued in appendices. The cost of this work to the railways has been borne entirely by the American Railway Association, and the total appropriations made since November, 1909, up to November 1912, has been $21,000, while the expenditures to the end of the same period were $21,011.41.

In addition to the above, some of the manufacturers have incurred large expenses through the use of their facilities and material when the investigations were made, the amount of which is not known.

During the year 1912 the engineer of tests made reports to the rail committee on: Abrasion test of rails on a revolving machine; Influence of titanium on Bessemer ingots and rails; Pipeless ingots; Transverse ductility of base of rails, and Influence of silicon on open-hearth ingots and rails.

The first report gave the results of abrasion tests of rails made at several different mills. The tests were made at the South Chicago works of the Illinois Steel Company on a "revolving machine," consisting of a circular track 20 ft. in diameter, on which a heavy beam revolved which could be given additional load by means of springs. Under the conditions of this test open-hearth steel of .74 per cent. carbon abraded more slowly than Bessemer steel of .50 to .54 per cent. carbon, but the tests were not entirely satisfactory and were few in number.

The next study gave the results of an investigation made at the works of the Lackawanna Steel Company at Buffalo, to determine the influence of titanium on Bessemer steel ingots and rails. A series of heats was made with treatments varying from nothing to .6 per cent. metallic titanium added in the form of a cold 15 per cent. alloy. According to the results obtained, the use of amounts of .1 per cent. or more of metallic titanium in the manner mentioned, prevents the "honeycombed" condition of the upper part of the ingot found in plain Bessemer steel, but was also attended with a larger and deeper "pipe." The heavy segregation or concentration of carbon, phosphorus and sulphur found in the interior and upper part of ingots of plain Bessemer steel was largely restrained, but the mild negative segregation found in the interior and lower part of the ingot was not materially altered. The brittle zone found in rail of plain Bessemer steel from the upper part of the ingot, as determined by drop and tensile tests, was avoided, but the properties of the rail from the lower two-thirds of the ingot were not changed. Large internal flaws were found in rail considerably lower down from the top of the ingot in steel treated as mentioned, than in rail made from plain steel. Treatments with .05 per cent. metallic titanium produced the above results only in part, but treatment above .1 per cent. had only little additional influence.

The third report dealt with an investigation of two special ingots made by the Standard Steel Works Company at Burnham, Pa., by a process which prevents the formation of a "pipe" in the interior of the ingot. The steel was acid open-hearth steel treated with titanium. The ingots were shipped to the Maryland Steel Company at Sparrows Point, Md., where they were tested. The main feature of the casting process was a sand core on top of the iron mold. The ingots were cupped down at the top, but contained no interior pipe.

The fourth report described a method for determining the transverse ductility of the bottom of the base of a rail and the load required to break the flanges of a rail supported near the edges of the flanges. The results were given of a few tests made at Buffalo at the works of the Lackawanna Steel Company, of Bessemer and open-hearth rails. The method of making the tests was to support a piece of rail about two ft. long on two supports placed opposite each other near the edges of the flanges under the middle of the length of the rail. The supports were six in. long and placed one-half in. in from the sides of the flanges. The load was applied in the test machine to the top of the rail at the middle. The method may be considered a means of determining the strength of the flange and of determining the transverse properties of the base of the rail, as regards the transverse ductility of the metal in the base and the presence of structural flaws such as seams.

The last report gave the results of an investigation made at the Gary works of the Illinois Steel Company on the influence of silicon on open-hearth ingots and rails. A heat of about .15 per cent. silicon was used and a series of higher silicons in this steel up to above .5 per cent. was obtained by means of mold additions of finely crushed ferro-silicon. With about one-fourth per cent. silicon or more the ingots were free from most of the honeycomb present in the upper third of the ingot with the heat amount of silicon, but they also had larger pipes. The higher silicons also had less concentrated segregation of carbon, phosphorus and sulphur. Silicon had but little influence on the results in the drop test. When tested in the test machine as a beam, the stiffness and breaking load of the rails increased with increase of silicon, while their ductility was not greatly influenced. In longitudinal tensile tests, the yield point and tensile strength increased somewhat with the increase of silicon, while the ductility remained about the same. In tests of the flange, the load required to break the flange increased somewhat as the silicon increased, while the transverse ductility of the base remained about the same.

The above work concerning both titanium and silicon indicate that they tend to restrain segregation of carbon, phosphorus and sulphur, but used as they were in this work they were attended with larger pipes. This suggests the idea that in order to obtain the full benefits of their use, a method of casting the ingots is necessary whereby the pipe is avoided or minimized.

Testing Each Ingot.

The question of testing each ingot has been quite thoroughly considered by correspondence and by discussion, and the committee recommends that no change be made in the specifications in this respect at present, for the following reasons:

(a) The tests now required by the specifications are sufficient to determine the character of the metal in the heat. In

so far as it is intended to discover specific flaws in the rail, additional tests would have relatively little value, as these defects are quite local, and are apt to occur in any part of the ingot, or rail-bar, so that the presence or absence of internal defects in the piece tested is no certain criterion of the presence or absence of similar defects in other parts of the same bar.

(b) The character of the metal in the rails of one heat varies *down* the ingot more than it does from one ingot to another, and in making the complete drop test of an open-hearth heat, the three tests made from approximately the poorest parts of the ingots designate the average of the poorest part of the metal fully as well as if we tested a piece from each ingot.

(c) Careful examination in detail of the many tests of open-hearth rail made in the last two years on the New York Central Lines fails to show any necessity for the testing of each individual ingot.

RECOMMENDATIONS FOR WORK IN 1913.

The subjects recommended for assignment to the committee for 1913 are the same as those already assigned for the year 1912, and in addition the subject of rail joints.

The general line of investigation which the committee has in view for Mr. Wickhorst is submitted below, and embraces a great deal more work than he can cover in any one year. The main point kept in mind in the work of the last two or three years has been to conduct it so as to bring out if possible information useful in improving rails for the purpose of making them uniformly safe, and it is probable that this must continue to be our guiding principle for some time to come. Investigations intended to improve the wearing properties of rails must, it would seem, be considered as secondary to those which have uniform safety as the prime consideration. It soon developed that the type of rail failure which was uppermost in our attention a few years ago, namely, split and mashed heads, was traceable to the interior condition of the ingot and our work has consisted therefore largely of "ingot" studies. Recently, failures classified as broken rails and broken base, have been brought more to our attention, due largely to last winter's crop of broken rails. It seems that such failures are largely attended or perhaps caused by deep seams in the base of the rail and it is now proposed that the work of the immediate future be directed toward throwing light on the cause of such seams and methods for their prevention.

CONCLUSIONS.

The committee makes the following recommendations:

(1) That the revision of the specifications for carbon steel rails be approved for printing in the manual.

(2) That Form M. W. 401, "Report of Mill Inspection," as revised, be approved for substitution in the manual for the present standard form.

(3) That Form M. W. 402, "Certificate of Inspection," as revised, be approved for substitution in the manual for the present standard form.

(4) That Form M. W. 407, "Laboratory Rail Report" be approved for substitution in the manual for the present standard form.

(5) That Form M. W. 418, "Tabulation of Results of Mill Inspection of Rails," as revised, be approved for substitution in the manual for the present standard form.

W. C. Cushing, chairman (Pa. Lines); R. Montfort, vice-chairman (L. & N.); E. B. Ashby (L. V.), J. A. Atwood (P. & L. E.), A. S. Baldwin (I. C.), J. B. Berry (C. R. I. & P.), M. L. Byers (D. & H.), Chas. S. Churchill (H. & W.), F. A. Delano (Wabash), P. H. Dudley (N. Y. C. Lines), C. H. Ewing (Atlantic City Ry.), L. C. Fritch (C. G. W.), C. W. Huntington (C. R. R. of N. J.), J. D. Isaacs (S. P.), Thos. H. Johnson (Pa. Lines), H. G. Kelley (G. T.), C. A. Morse (A. T. & S. F.), G. W. Kittredge (N. Y. C. & H. R.), Jos. T. Richards (P. R. R.), J. P. Snow (Cons. Engr.), A. W. Thompson (B. & O.), R. Trimble (Pa. Lines), M. H. Wickhorst, Committee.

SPECIFICATIONS FOR CARBON AND STEEL RAILS.

Inspection.

1. *Access to Works*—Inspectors representing the purchaser shall have free entry to the works of the manufacturer at all times while the contract is being executed, and shall have all reasonable facilities afforded them by the manufacturer to satisfy them that the rails have been made in accordance with the terms of the specifications.

2. *Place for Tests*—All tests and inspections shall be made at the place of manufacture, prior to shipment, and shall be so conducted as not to interfere unnecessarily with the operation of the mill.

Material.

3. *Material*—The material shall be steel made by the Bessemer or open-hearth processes as provided by the contract.

Chemical Requirements.

4. *Chemical Composition*—The chemical composition of each heat of the steel from which the rails are rolled, determined as prescribed in section 7, shall be within the following limits:

Elements.	Per Cent for Bessemer Process: 70 lbs. and Over, but Under 85 lbs.	Per Cent for Bessemer Process: 85-100 lbs. Inclusive.
Carbon	0.40 to 0.50	0.45 to 0.55
Phosphorus, not to exceed	0.10	0.10
Manganese	0.80 to 1.10	0.80 to 1.10
Silicon, not to exceed	0.20	0.20

Elements.	Per Cent for Open-Hearth Process: 70 lbs. and Over, but Under 85 lbs.	Per Cent for Open-Hearth Process: 85-100 lbs. Inclusive.
Carbon	0.53 to 0.66	0.63 to 0.76
Phosphorus, not to exceed	0.04	0.04
Manganese	0.60 to 0.90	0.60 to 0.90
Silicon, not to exceed	0.20	0.20

5. *Average Carbon*—It is desired that the percentage of carbon in an entire order of rails shall average as high as the mean percentage between the upper and lower limits specified.

6. *Modification of Carbon for Low Phosphorus*—When the material used at any mill is such that the average phosphorus content of the ingot metal used in the Bessemer process is running below 0.08 and in the open-hearth process is running below 0.03, and if it seems mutually desirable, the carbon may be increased at the rate of 0.035 for each 0.01 that the phosphorus content of the ingot metal used averages below 0.08 for Bessemer steel, or 0.03 for open-hearth steel.

7. *Analyses*—In order to ascertain whether the chemical composition is in accordance with the requirements, analyses shall be furnished as follows:

(a) For Bessemer process the manufacturer shall furnish to the inspector, daily, carbon determinations for each heat before the rails are shipped, and two chemical analyses every 24 hours representing the average of the elements, carbon, manganese, silicon, phosphorus and sulphur contained in the steel, one for each day and night turn respectively. These analyses shall be made on drillings taken from the ladle test ingot not less than ⅛ in. beneath the surface.

(b) For open-hearth process, the makers shall furnish the inspectors with a chemical analysis of the elements, carbon, manganese, silicon, phosphorus and sulphur, for each heat.

(c) On request of the inspector, the manufacturer shall furnish a portion of the test ingot for check analyses.

Physical Requirements.

8. *Physical Qualities*—Tests shall be made to determine:

(a) Ductility or toughness as opposed to brittleness.

(b) Soundness.

9. *Method of Testing*—The physical qualities shall be determined by the drop test.

10. *Drop Testing Machine*—The drop testing machine used shall be the standard of the American Railway Engineering Association.

(a) The tup shall weigh 2,000 lbs., and have a striking face with a radius of 5 in.

(b) The anvil block shall weigh 20,000 lbs., and be supported on springs.

(c) The supports for the test pieces shall be spaced 3 ft. between centers and shall be a part of, and firmly secured, to the anvil. The bearing surfaces of the supports shall have a radius of 5 in.

11. *Pieces for Drop Test*—Drop tests shall be made on pieces of rail not less than 4 and not more than 6 ft. long. These test pieces shall be cut from the top end of the top rail of the ingot, and marked on the base or head with gage marks 1 in. apart for 3 in. each side of the center of the test piece, for measuring the ductility of the metal.

12. *Temperature of Test Pieces*—The temperature of the test pieces shall be between 60 and 100 deg. Fahrenheit.

13. *Height of Drop*—The test piece shall, at the option of the inspector, be placed head or base upwards on the supports, and be subjected to impact of the tup falling free from the following heights:

For 70-lb. rail..............................16 ft.
For 80, 85 and 90-lb. rail.....................17 ft.
For 100-lb. rail...............................18 ft.

14. *Elongation or Ductility*—(a) Under these impacts the rail under one or more blows shall show at least 6 per cent. elongation for 1 in., or 5 per cent. each for two consecutive inches of the 6-in. scale, marked as described in section 11.

(b) A sufficient number of blows shall be given to determine the complete elongation of the test piece of at least every fifth heat of Bessemer steel and of one out of every three test pieces of a heat of open-hearth steel.

15. *Permanent Set*—It is desired that the permanent set after one blow under the drop test shall not exceed that in the following table, and a record shall be made of this information.

Section.	Rail. Weight per Yard.	Rail. Moment of Inertia.	Permanent Set, Measured by Middle Ordinate in Inches in a Length of 3 ft. Bessemer Process.	Permanent Set, Measured by Middle Ordinate in Inches in a Length of 3 ft. Open-Hearth Process.
A.R.A.-A.......	100	48.94	1.65	1.45
A.R.A.-B......	100	41.30	2.05	1.80
A.R.A.-A......	90	38.70	1.90	1.65
A.R.A.-B......	90	32.30	2.20	2.00
A.R.A.-A......	80	28.80	2.85	2.45
A.R.A.-B......	80	25.00	3.15	2.85
A.R.A.-A......	70	21.05	3.50	3.10
A.R.A.-B......	70	18.60	3.85	3.50

16. *Test to Destruction*—The test pieces which do not break under the first or subsequent blows shall be nicked and broken, to determine whether the interior metal is sound.

17. *Bessemer Process Drop Tests*—One piece shall be tested from each heat of Bessemer steel.

(a) If the test piece does not break at the first blow and shows the required elongation (section 14), all of the rails of the heat shall be accepted, provided that the test piece when broken does not show interior defect.

(b) If the test piece breaks at the first blow, or does not show the required elongation (section 14), or if the test piece does not break and shows the required elongation, but when broken shows interior defect, all of the top rails from that heat shall be rejected.

(c) A second test shall then be made of a test piece selected by the inspector from the top end of any second rail of the same heat, preferably of the same ingot. If the test piece does not break at the first blow, and shows the required elongation (section 14), all of the remainder of the rails of the heat shall be accepted, provided that the test piece when broken does not show interior defect.

(d) If the test piece breaks at the first blow, or does not show the required elongation (section 14), or if the test piece does not break and shows the required elongation, but when broken shows interior defect, all of the second rails from that heat shall be rejected.

(e) A third test shall then be made of a test piece selected by the inspector from the top end of any third rail of the same heat, preferably of the same ingot. If the test piece does not break at the first blow and shows the required elongation (section 14), all of the remainder of the rails of the heat shall be accepted, provided that the test piece when broken does not show interior defect.

(f) If the test piece breaks at the first blow, or does not show the required elongation (section 14), or if the test piece does not break and shows the required elongation, but when broken shows interior defect, all of the remainder of the rails from that heat shall be rejected.

18. *Open-Hearth Process Drop Tests*—Test pieces shall be selected from the second, middle and last full ingot of each open-hearth heat.

(a) If two of these test pieces do not break at the first blow, and if both show the required elongation (section 14), all of the rails of the heat shall be accepted, provided that none of the three test pieces when broken show interior defect.

(b) If two of the test pieces break at the first blow, or do not show the required elongation (section 14), or if any of the three test pieces when broken show interior defect, all of the top rails from that heat shall be rejected.

(c) Second tests shall then be made from three test pieces selected by the inspector from the top end of any second rails of the same heat, preferably of the same ingots. If two of these test pieces do not break at the first blow and if both show the required elongation (section 14), all of the remainder of the rails of the heat shall be accepted, provided that none of the three test pieces when broken show interior defect.

(d) If two of these test pieces break at the first blow, or do not show the required elongation (section 14), or if any of the three test pieces when broken show interior defect, all of the second rails of the heat shall be rejected.

(e) Third tests shall then be made from three test pieces selected by the inspector from the top end of any third rails of the same heat, preferably of the same ingots. If two of these test pieces do not break at the first blow, and if both show the required elongation (section 14), all of the remainder of the rails of the heat shall be accepted, provided that none of the three test pieces when broken show interior defect.

(f) If two of these test pieces break at the first blow, or do not show the required elongation (section 14), or if any of the three test pieces when broken show interior defect, all of the remainder of the rails from that heat shall be rejected.

19. *No. 1 Rails.*—No. 1 classification rails shall be free from injurious defects and flaws of all kinds.

20. *No. 2 Rails*—(a) Rails, which, by reason of surface imperfections, or for causes mentioned in section 30, hereof, are not classed as No. 1 rails, will be accepted as No. 2 rails, but No. 2 rails which contain imperfections in such number or of such character as will, in the judgment of the inspector, render them unfit for recognized No. 2 uses, will not be accepted for shipment.

(b) No. 2 rails to the extent of 5 per cent. of the whole order will be received. All rails accepted as No. 2 rails shall have the ends painted white and shall have two prick punch marks on the side of the web near the heat number near the end of the rail, so placed as not to be covered by the splice bars.

Details of Manufacture.

21. *Quality of Manufacture*—The entire process of manufacture shall be in accordance with the best current state of the art.

22. *Bled Ingots*—Bled ingots shall not be used.

23. *Discard*—There shall be sheared from the end of the bloom, formed from the top of the ingot, sufficient metal to secure sound rails.

24. *Lengths*—The standard length of rails shall be 33 ft., at a temperature of 60 deg. Fah. Ten per cent. of the entire order will be accepted in shorter lengths varying by 1 ft. from 32 ft. to 25 ft. A variation of ¼ in. from the specified lengths will be allowed. No. 1 rails less than 33 ft. long shall be painted green on both ends.

25. *Shrinkage*—The number of passes and speed of train shall be so regulated that on leaving the rolls at the final pass, the temperature of the rail will not exceed that which requires a shrinkage allowance at the hot saws, for a rail 33 ft. in length and of 100 lbs. section, of 6¾ in. and ⅛ in. less for each 10 lbs. decrease in section.

26. *Cooling*—The bars shall not be held for the purpose of reducing their temperature, nor shall any artificial means of cooling them be used after they leave the finishing pass. Rails, while on the cooling beds, shall be protected from snow and water.

27. *Section*—The section of rails shall conform as accurately as possible to the template furnished by the railroad company. A variation in height of 1/64 in. less or 1/32 in. greater than the specified height and 1/16 in. in width of flange, will be permitted; but no variation shall be allowed in the dimensions affecting the fit of the splice bars.

28. *Weight*—The weight of the rails specified in the order shall be maintained as nearly as possible, after complying with the preceding section. A variation of one-half of 1 per cent. from the calculated weight of section, as applied to an entire order, will be allowed.

29. *Payment*—Rails accepted will be paid for according to actual weights.

30. *Straightening*—(a) the hot straightening shall be carefully done, so that gagging under the cold presses will be reduced to a minimum. Any rail coming to the straightening presses showing sharp kinks or greater camber than that indicated by a middle ordinate of 4 in. in 33 ft., for A. R. A. type of sections, or 5 in. for A. S. C. E. type of sections, will be at once classed as a No. 2 rail. The distance between the supports of rails in the straightening presses shall not be less than 42 in. The supports shall have flat surfaces and be out of wind.

(b) Rails heard to snap or check while being straightened shall be at once rejected.

31. *Drilling*—Circular holes for joint bolts shall be drilled to conform accurately in every respect to the drawing and dimensions furnished by the railroad company.

32. *Finishing*—(a) All rails shall be smooth on the heads, straight in line and surface, and without any twists, waves or kinks. They shall be sawed square at the ends, a variation of not more than 1/ 32 in. being allowed; and burrs shall be carefully removed.

(b) Rails improperly drilled or straightened, or from which the burrs have not been removed, shall be rejected, but may be accepted after being properly finished.

(c) When any finished rail shows interior defects at either end or in a drilled hole the entire rail shall be rejected.

33. *Branding*—(a) The name of the manufacturer, the weight and type of rail, and the month and year of manufacture shall be rolled in raised letters and figures on the side of the web. The number of the heat and a letter indicating the portion of the ingot from which the rail was

made shall be plainly stamped on the web of each rail, where it will not be covered by the splice bars. The top rails shall be lettered "A," and the succeeding ones "B," "C," "D," etc., consecutively; but in case of a top discard of 20 or more per cent., the letter "A" will be omitted. All markings of rails shall be done so effectively that the marks may be read as long as the rails are in service.

(b) Open-hearth rails shall be branded or stamped "O.-H.," in addition to the other marks.

34. *Separate Classes*—All classes of rails shall be kept separate from each other.

35. *Loading*—All rails shall be loaded in the presence of the inspector.

Discussion on Rail.

Mr. Cushing: Apropos of the question of steel rails it is interesting to read the following remarks made by former president John Edgar Thomson in his annual report to the stockholders in 1864, nearly 50 years ago:

"The rapid destruction of iron under the high speeds and heavy locomotives now used upon railways, has become a subject of serious consideration, not only to the managers of these improvements in this country, but also in Europe. When the Pennsylvania Railroad was planned, a locomotive weighing 45,000 to 50,000 lbs. was considered as the extreme limit to these machines, justified by prudence. But the demands of the public for high speeds has compelled the introduction upon all thoroughfares of more powerful engines. These could only be obtained by adding to their dimensions and weight, which has produced its natural result—great wear and tear of iron rails and the superstructure of the road. This evil has been still further increased by the inferiority of the rails now manufactured, compared with those placed upon railways when the edge rail was first introduced. It was then deemed essential that rails should be made from the best refined iron produced from selected ores. The great increase in the demand for iron under the rapid development of the railway systems in England and this country soon caused the substitution of an inferior article, which seemed for a time to answer the purpose, but which experience has proven to be insufficient to resist the causes referred to, as continually operating for its destruction. A return to the quality of iron originally used on railways, would be the natural remedy for this difficulty, but this will require time, as none of the rail mills have the required furnaces to refine their metal. In Europe this subject has been longer considered, and the determination appears to be general, to gradually substitute a still more expensive material—either a rail made wholly of steel—with a steel head only—or the wearing surface converted into steel after the iron rail is made. The present high cost of rails made entirely of steel will probably prevent their general adoption, although the rapid destruction at the terminal and stations, where the iron rail in some positions does not last six months, will fully justify their introduction. For the purpose of testing the relative value of steel and iron rails in such positions, we have procured 150 tons of rails made wholly of cast steel. A trial is also being made of a rail with a steeled wearing surface passed through the rolls, when drawn from the converting furnace, which promises well. It is understood that favorable results have been obtained from rails, the top plate in the pile from which they were made being puddled steel. If the two metals can be firmly welded together, this improvement in railway bars will be generally adopted. This is a subject of such great importance to the company that it will continue to meet the earnest attention of your directors, and if necessary to effect the reformation desired in the quality of rails, it should become important to erect works to effect that object, such a policy will be adopted. The frequent renewal of rails is not only expensive, but it adds to the interruption of the traffic of the line."

The only conclusions we have to offer to the association for adoption this year are in line with proposed revisions of what is already in the Manual. As these changes are due to criticisms made at the last annual convention and those received during the year, it is presumed that they are in line with the wishes of the association, and I make the motion now for their adoption.

(Conclusions 1, 2, 3, 4 and 5 were adopted.)

H. M. Wickhorst: Taking the statistics of rail failures as published in one of our recent bulletins, 90 per cent of the failures can be divided into two general classes. First of all, we have failures of the crushed heads, split heads, and also in that should probably be included most of the web failures. This class of failures is traceable finally to the interior condition of the ingot from which the rails were made; that is, they are a matter of excessive segregation, which produces a brittleness in the interior of the section. Under wheel loads the head spreads sideways. The top metal is always ductile, but the interior metal may not be so, sometimes due to structural flaws or laminations, but most particularly due to excessive carbon and phosphorus, which makes extremely brittle non-ductile material inside, so that when the top of the head spreads sideways a crack develops internally and finally comes to the surface at the under side of the head at its junction with the web. Sometimes, in the case of a badly segregated rail, it will run farther into the web and come out to the surface at the side of the web. So a good many failures, classed as web failures, would come under that head. That would include probably 50 per cent of the failures. Then, second in the class, we have broken bases, and broken rails, which, I will simply state very briefly, we think we can now definitely trace to a seam in the bottom of the base. If the bottom of the base contains a seam, when excessive load comes on, when the load come on, for any reason, or if there is an eccentric bearing, then the seam opens, and if the seam happens to be away from the center a piece of the flange may break out and we get a moon-shaped or crescent break. If, however, as is more generally the case, the seam opens up near the center of the base, the base will open up and a piece of the flange start to break off, and then the break goes through the whole of the section. So what are classed as broken rails (square breaks—angular breaks), and base breaks in general, can be traced to the presence of a longitudinal seam in the bottom of the base. This will probably include about 40 per cent of the rail failures. These two classes will account of about 90 per cent of all the rail failures of the country. Now, to sum up, then, we may say 50 per cent of the rail problems consists in getting sound metal of fairly even composition and 40 per cent consists in so rolling the steel as to avoid the seams in the base.

A vote of thanks was offered to the committee.

The meeting adjourned until 9 a. m. Wednesday, March 19.

FIVE DIRECTORS OF THE A. S. C. E. HERE.

Professor G. F. Swain of Harvard University, president of the American Society of Civil Engineers, is attending the convention. It was interesting to note yesterday that in addition to President Swain and Vice-President C. S. Churchill at least two other members of the board of directors of this society were in attendance—C. F. Loweth and Lincoln Bush.

PRACTICAL MEN AT THE COLISEUM.

Considerable comment was heard at the Coliseum yesterday regarding the number of roadmasters and foremen who are visiting the show. One western road sent in a number of the foremen on its Illinois lines, while a division engineer of one of the large roads running east from Chicago sent a ticket to the Coliseum and a railroad pass to Chicago to each of his foremen with the suggestion that they attend some day this week. The increasing recognition of the value of this exhibit to the practical man is one of the best indications of its real merit.

WARWICK IN OUR MIDST.

William Jennings Bryan, Secretary of State of the United States, came as near being present at a meeting of the Railway Signal Association night before last as he may ever get. He attended the wedding, the preparations for which were begun almost before the Monday afternoon session, in the Florentine room of the Congress Hotel had adjourned. His coming was unheralded, his stay short—and diplomatic—and his departure unostentatious. Few besides those being married and those helping them get married knew he was there. The few stragglers from the R. S. A. meeting who saw him thought he was "Jim" Lorenz. But he was there, all right, and he dispensed silence and smiles, and kissed the bride with as much dignity and eclat as if he were concluding a treaty with the court of St. James. The bride, who was Miss Amy Wessel, is the daughter of an old-time friend and neighbor of Mr. Bryan's.

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Trabue, H. H., Asst. Ch. Eng., N. C. & St. L. Ry., Nashville, Tenn.
Tratman, E. E. R., Resident Editor, Engineering News, Chicago, Ill.
Trench, W. I., Div. Eng., B. & O. R. R., Baltimore, Md.
Trimble, Robert, Director, Ch. Eng. M. W., N. W. System, Pennsylvania Lines, Pittsburgh, Pa.
Turneaure, F. E., Dean, Col. of Eng., Univ. of Wis., Madison, Wis.
Van Auken, K. L., Editor, Ry. Eng. and M. W., Chicago, Ill.
Van Hagan, L. F., Asso. Prof. Univ. of Wis., Madison, Wis.
Vanneman, C. R., Ch. Div. Trans., Public Service Com., Albany, N. Y.
Von Schrenk, Herman, Dr., Supt. Timber Pres., Rock Island-Frisco Rys., St. Louis, Mo.
Walker, I. O., Asst. Eng., N. C. & St. L. Ry., Paducah, Ky.
Walker, W. K., Div. Eng., Mo. Pac. Ry., Wichita, Kan.
Wallace, W. A., Chicago, Ill.
Wendt, Edwin F., First Vice-President, Asst. Eng., P. & L. E. R. R., Pittsburgh, Pa.
West, O. J., Ch. Eng., Massey Co., Chicago, Ill.
White, R. C., Div. Eng., Mo. Pac. Ry., Little Rock, Ark.
Wickhorst, M. H., Eng. of Tests, Rail Committee, Chicago, Ill.
Wilgus, H. S., Eng. M. W., P. S. & N. R. R., Angelica, N. Y.
Williams, S. N., Prof. Civil Eng., Cornell College, Mt. Vernon, Iowa.
Wilson, A. O., Div. Eng., S. A. L. Ry., Hamlet, N. C.
Wilson, G. L., Eng. M. W., Twin City Rapid Transit Co., Minneapolis, Minn.
Wishart, J. G., Chief Draftsman, C., R. I. & P. Ry., Chicago, Ill.
Wood, B. A., Ch. Eng., M. & O. R. R., Mobile, Ala.
Woods, H. A., Asst. Ch. Eng., Gr. Tr. Pac. Ry., Montreal.
Yates, J. J., Bridge Eng., Central R. R. of N. J., New York.
Young, R. C., Ch. Eng., L. S. & I. and Munising Rys., Marquette, Mich.

GUESTS.

Albers, J. L., Designing Eng., N. C. & St. L., Nashville, Tenn.
Ashenders, R. C., Asst. Roadmaster, B. & A., Boston, Mass.
Atkinson, L. H., Bethlehem Steel Co., South Bethlehem, Pa.
Bragg, R. R., Asst. Eng., C., R. I. & P. Ry., Topeka, Kan.
Brown, Claude, Asst. Eng., B. & O. R. R., Chicago, Ill.
Cambier, Jacob, Chemist, C. F. & I. Co., Pueblo, Colo.
Carpenter, H. R., Eng. M. of W., Mo. Pac., St. Louis, Mo.
Church, S. R., Barrett Mfg. Co., New York, N. Y.
Darling, P. W., Roadmaster, Lackawanna, Scranton, Pa.
Dayton, C. A., D., L. & W., Syracuse, N. Y.
Giel, M., Roadmaster, Lackawanna, Stroudsburgh, Pa.
Hanna, M. A., Roadmaster, T. & N. O., Beaumont, Texas.
Harley, Roadmaster, Lackawanna, Binghamton, N. Y.
Hench, N. M., Eng. Track Appliances, Philadelphia, Pa.
Holland, S. Reid, St. Louis, Mo.
Hunter, J. W., Div. Eng., C. & E. I. Ry., Salem, Ill.
Iback, B. F., Pottsville, Pa.
Jackson, A. A., Asst. Eng., B. & O. R. R., Baltimore, Md.
Johnson, C. H., Eng. Const., N. C. & St. L., Nashville, Tenn.
Kerwin, John, Supt. of Track, H. & Mt. E. Ry., Detroit, Mich.
Kirby, J. L., Seaboard Air Line, Atlanta, Ga.
Mercer, Chas. A., The Penn. Steel Co., Steelton, Pa.
Mitchell, G. A., Supt. B. & B., Grand Trunk, Montreal, Can.
Moorshead, O., Newton, Kan.
Morrill, C. R., Asst. Supt., G., H. & S. A., El Paso, Texas.
Pickles, J. L., D., W. & P. Ry., Duluth, Minn.
Pratt, L. P., Yarnell Co., Philadelphia, Pa.
Raymer, I. S., Asst. Sig. Eng., B. & L. E., Pittsburgh, Pa.
Schlesinger, G. F., Asst. Eng., C., R. I. & P. Ry., Topeka, Kan.
Schofield, J., Can. Nor. Ry., Winnipeg, Can.
Sharp, T. F., Asst. Supt., G., H. & S. A., San Antonio, Texas.
Shipley, L. B., Barrett Mfg. Co., New York, N. Y.
Stark, C. W., Engineering Record, New York.
Steinmayer, O. C., Treating Inspr., Frisco Lines, Springfield, Mo.
Stoll, H. E., Bethlehem Steel Co., South Bethlehem, Pa.
Tripp, R. G., Asst. Eng., C., R. I. & P. Ry., Topeka, Kan.
Waber, J. W. Eng. in Charge of Construction, C., R. I. & P. Ry., Carlisle, Iowa.
Wickham, C. E., Div. Eng., D., L. & W., Buffalo, N. Y.
Wynne, James, Roadmaster, Lackawanna, Hoboken, N. J.
Young, J. B., Chemist, P. & R., Reading, Pa.

After careful consideration for the past year, the American Railway Engineering Association has made application for second-class mail privileges for the bulletins of the association. If this can be secured it will mean a saving of $500 annually in the expenses of mailing.

J. B. BERRY TO BE ASSISTANT TO THE PRESIDENT.

J. B. Berry is to become assistant to the president of the Rock Island Lines, being succeeded as chief engineer, as already announced in the Daily, by C. A. Morse, chief engineer of the Santa Fe.

Mr. Berry has been chief engineer of the Rock Island Lines since 1905. He was for a while, when the Rock Island and Frisco Lines were under the same financial control, also consulting engineer of the Frisco. Before coming to the Rock Island he was for seven years chief engineer of the Union Pacific.

Mr. Berry entered the service of the Chicago & Northwestern in 1878, and was employed in its engineering department until 1893. He then went to Omaha as chief engineer of the Fremont, Elkhorn & Missouri Valley, where he remained until he became chief engineer of the Union Pacific.

Mr. Berry's work in the reconstruction of the Union Pacific was one of the notable pieces of engineering work in the railway history of the country, and he has ever since occupied a prominent place among railway engineers.

NEW COAL HANDLING BRIDGE AT DULUTH, MINN.

A new dock and storage plant for unloading, stocking and reshipping coal has recently been completed at Duluth for the Clarkson Coal & Dock Co. The plant is reached by boat from a slip on one side of the property and provision has been made in the design of the plant for unloading from a second slip, which may be located along the other side of the storage ground in the future. The storage space is 630 ft. wide and has a capacity of upwards of 200,000 tons. It is spanned by two steel bridges placed end to end which are built in duplicate, with the exception that the unloading machinery which will be used to unload boats in the future slip, if this is added, has not been placed as yet. The span of each bridge between the tower leg and the shear leg is 201 ft., with a 68-ft. cantilever outside of the tower leg extending over the slip in the case of one of the bridges, and over a storage pile in the other case. Each bridge also has an 80-ft. cantilever extending over the storage space between the two bridges. The shear legs of the two bridges are 160 ft. apart so that the ends of the two cantilever arms just clear each other. This arrangement allows the two bridges to be operated independently or to be lined up and operated in tandem. The storage piles are about 40 ft. high and the clearance to the underside of trusses is 55 ft.

One of the unusual features in the design of these bridges is the use of single rail trucks under both the tower and shear legs. This feature was made necessary by limitations imposed by the owners and necessitated numerous changes in the design from the type of bridge ordinarily used for this purpose. In order to secure longitudinal stability for the bridge, tower bracing is provided extending back two panel points from the leg, or about 27 ft. The tower leg, the tower bracing and the bridge span are thus rigidly connected. The span is supported on the shear leg by a nest of ball bearings which allows movement in both directions. The single rail trucks have center pins which carry the load from the tower and allow movement of the trucks due to inequalities in the track. Roller bearings are provided at the ends of these trucks.

The coal is unloaded from boats by a 2.5 ton grab bucket operating from the cantilever boom over the slip. This boom is made to swing vertically in order to clear the masts of vessels in the slip. The bucket is operated by Watson's cable rig and remote control from an operator's house on the tower leg of the adjacent bridge. The bucket is able to make two trips per minute, giving it a capacity of 300 tons per hour. The unloading bucket dumps the coal into a 10-ton hopper, supported by the tower bracing, from which it is fed by a

Coal Bridge of the Clarkson

reciprocating feeder to a 36-in. belt conveyor supported from the lower chord of the bridge. This belt conveyor extends nearly to the middle of the bridge span above the storage pile. Coal intended for storage under the main span of this bridge can be deposited at any desired point by the use of a shuttle conveyor, which is supported under the main conveyor, and can be moved back and forth on the bridge to bring its discharge end to any desired point.

If it is desired to carry the coal from the boat to the screening plant at the shear leg of the first bridge, the shuttle conveyor is arranged to receive the coal from the first conveyor and deposit it on a third conveyor, which discharges it into a 40-ton hopper carried by the shear leg. This hopper can feed the mine-run coal directly into standard gage cars on the two tracks adjacent to the shear leg or into the screening plant supported on the shear leg from which the slack and lump coal can be loaded directly or placed in bins for later shipment, as desired. A Christy box car loader is provided below the screening plant in case it is necessary to load the coal into box cars.

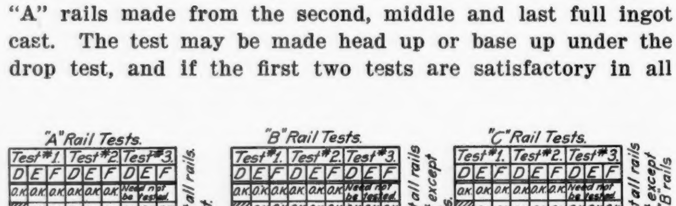
When it is desired to store coal in the pile between the two shear legs under the inside cantilever arms the belt conveyors are so adjusted over the shear leg of the first bridge that the coal is carried past this point instead of being dropped into the hopper. The coal received by the conveyor on the cantilever arm of the first bridge can either be deposited directly into the storage pile under that arm or fed to the conveyor under the cantilever arm of the second bridge when the two are lined for operation in tandem. The latter conveyor carries the coal past the shear leg of the second bridge and deposits it on a shuttle conveyor under the main span of that bridge which can place it either in the storage pile under that span or in the screening and loading plant on the shear leg of that bridge, which is a duplicate of the one described for the first bridge.

This arrangement of belt conveyors is so complete that it is possible to secure almost any combination and by adjustment of the shuttle conveyor under each bridge and the tripping arrangements at the ends of the conveyors, coal can be deposited at almost any desired point. For reclaiming the coal from the storage piles, a 2.5-ton grab bucket is operated on the lower chord of each bridge. These buckets are dumped directly into the large hoppers over the screening and loading plant.

The belt conveyor equipment for the entire bridge was furnished by the Robins Belt Conveyor Co., Chicago. The entire bridge was designed and constructed by the Roberts & Shaefer Co., Chicago, under the direction of E. E. Barrett, chief engineer.

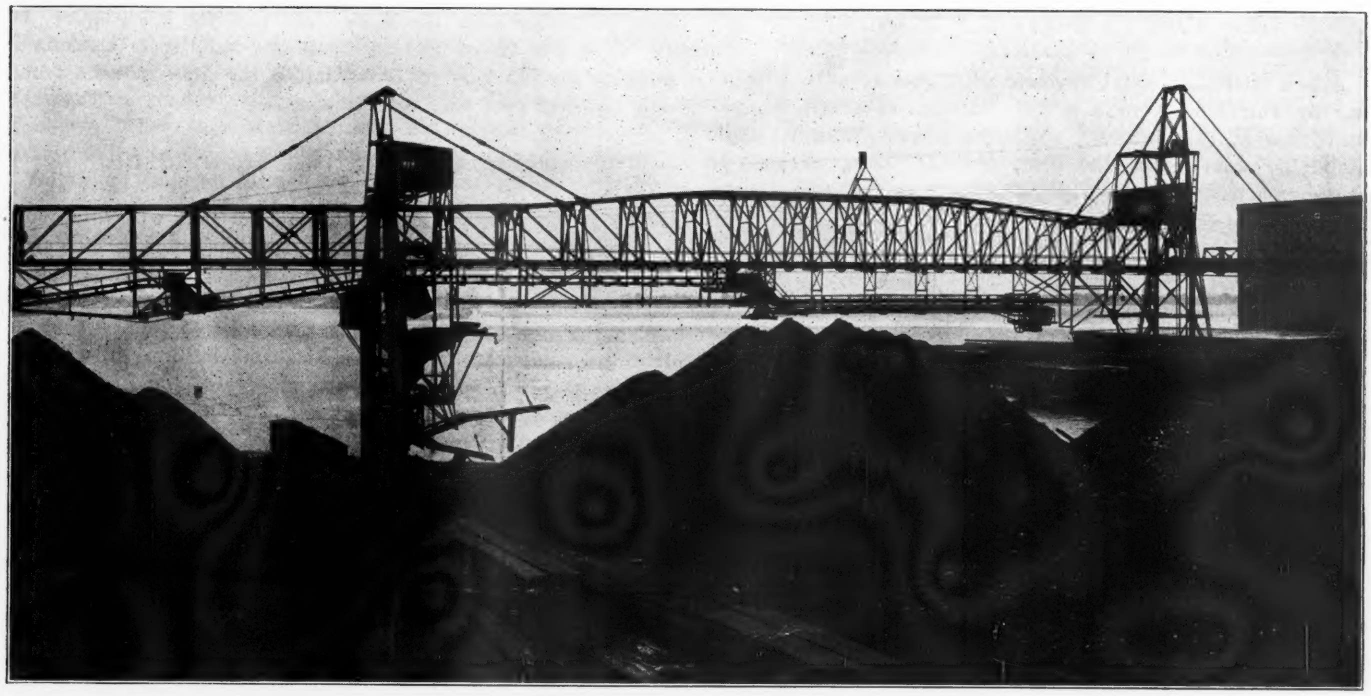
KEY TO 1912 A. R. E. A. OPEN HEARTH STEEL RAIL SPECIFICATIONS.

To simplify the duties of the inspectors at the rail mills and to enable them to know immediately the correct action to take when inspecting rails which are being rolled under the new specifications of the American Railway Engineering Association, adopted last March, Robert W. Hunt & Company have prepared a key for the use of their inspectors which presents the specifications at a glance. Under the new specifications, if the chemical analysis is satisfactory, three test pieces are taken from each heat from the top end of "A" rails made from the second, middle and last full ingot cast. The test may be made head up or base up under the drop test, and if the first two tests are satisfactory in all



Key for the Inspection of Rail.

respects, the third need not be made. To pass the test satisfactorily the specimen must not break on the first blow of the drop, indicated by column D in the diagram, must show 6 per cent. elongation in one inch or 5 per cent. in two consecutive inches as the result of one or more blows, indicated by column E in the diagram, and must show no interior defect or fracture when broken, indicated by column F. A shaded square in the diagram indicates a failure, in which event the inspector's course of procedure will be outlined as



Coal and Dock Co., Duluth, Minn.

shown at the right. A cross in the diagram shows possible unnecessary tests.

Referring to the diagram, the inspector can tell at a glance, for instance, if one specimen failed under the drop test and in elongation, but the other two tests were satisfactory in all details, that all rails of the heat should be accepted, while, on the other hand, the key shows that if the first test specimen fails under the drop test and the second in elongation, all the "A" rails should be rejected. Where the "A" rails are rejected the key shows likewise the action in testing "B" and also "C" rails.

This diagram applies for the proposed revised 1913 American Railway Engineering Association specifications, with the exception that all three test pieces must be broken and must all be free from interior defects to insure acceptance. Therefor, the cross in columns F of tests two and three should be omitted. The new specifications also require that one test piece from each heat must be struck repeated blows to determine the full elongation.

SIGNAL APPLIANCES ASSOCIATION MOVING PICTURES.

The Signal Appliances Association will give an exhibition of moving pictures at 166 N. State street, Chicago, at 3:00 o'clock p. m. on Thursday. The Richmond pictures, some new films on "Keeping the Blocks Open" in the Cascades and some other new pictures will be shown.

THE WEATHER.

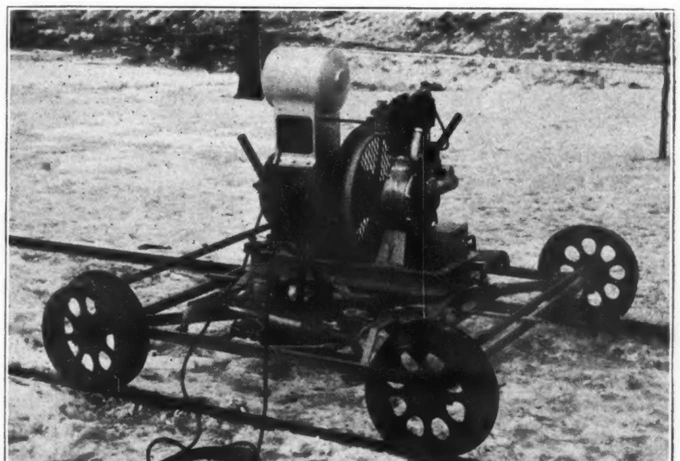
A year ago the convention of the Railway Engineering Association was held in the midst of a severe blizzard. This year's weather has not been exactly all that could be desired, but it has been a marked improvement, and on the whole has been satisfactory, considering that the month is March.

AN ELECTRIC SIGNAL BONDING OUTFIT.

An electric signal bonding outfit has been designed by the Chicago Pneumatic Tool Co. to furnish electric current for the operation of the drills for signal bonding. This apparatus consists of a single cylinder, 4-cycle gasolene engine, direct connected to a 1¼ k. w. generator, wound for 25 volts. The engine and dynamo are direct connected and mounted on a welded steel frame made of 3-in. channel steel. When detached from the truck they can be equipped with two handles so that the entire outfit can easily be carried by two men.

The generating unit may also be mounted on a 4-wheel truck with a welded channel steel frame. This truck has a wheel base of 50 in. The generating outfit is held to the truck frame by two bolts, which may be readily removed if desired. The weight of this 4-wheel truck is 130 lbs., and the combined weight of the truck and generator is about 500 lbs.

The engine develops 5 h. p. at normal speed of 1,500 r. p. m. Both valves are mechanically operated. The hardened steel crank shaft running in ball bearings is entirely enclosed and dust-proof. Lubrication is provided by a force feed oiler which takes care of all bearings except those of the dynamo.



Electric Rail Bonding Outfit.

Ignition is by means of a Bosch high-tension magneto, and cooling is effected by means of a fan-shaped fly wheel of large diameter. The switchboard has provision for making connections to two electric bonding drills. A fuse block is enclosed in the switch case.

NEW TYPE OF SHEFFIELD STANDPIPE.

A new telescopic spout Sheffield standpipe, recently brought out by Fairbanks, Morse & Co., Chicago, is shown for the first time at the railway appliance show. The Sheffield standpipe was one of the first to make its appearance in the field and it has been constantly improved. The lower

New Sheffield Standpipe.

part of the new No. 11 pipe is similar to the Nos. 6, 7, 8 and 10 Sheffield columns, having the Sheffield water balanced horizontal main valve and regularly provided with automatic relief valve, which takes care of water hammer in mains having high pressure.

The spout is the distinctive feature of the new No. 11 standpipe. In addition to a vertical movement of five ft. at the end of spout, it has a lateral movement of about four ft., and a "cross-track" movement of about three ft. In other words, the end of the spout will describe an oval about three by four ft., so that it is unnecessary to spot the man-hole so exactly as with other types of standpipes. This oval movement feature also lessens the chances for damaging the pipe should the engine move while taking water.

FLASH LIGHT INVENTOR AWARDED NOBEL PRIZE.

The Nobel prize for physics for 1912 was awarded to Gustaf Dalen of Stockholm for his inventions of the flash light and sun valve, both of which have been such great aids to navigation. These devices have been adopted all over the world for marine signaling, and the fact that the inventor was awarded the Nobel Prize for his inventions speaks much for their merit.

The application of the flashlight to railway signaling was described in the Railway Age Gazette of March 7, and in the Signal Engineer for March, 1913. As mentioned the flashlight is being introduced by the Commercial Acetylene Railway Light & Signal Co., New York, and in its first installation in the west was on an automatic block signal near Maywood, Ill., on the Chicago Great Western. The light it produces is visible further than the steady light ad the colors are more fully brought out. A tank of acetylene is placed at the foot of the mast and the gas is piped up the mast to the lamp, inside of which the flashing device is placed. The flasher is controlled by a diaphragm valve, and produces 60 flashes per min.

Recent experience shows that the gas is ignited by a pilot flame which burns continuously and that the total consumption, including both the flash light and the pilot flame, is 4-5 of a cu. ft. of gas in 24 hours, and it is therefore, possible to run one of these lights for nine months from one tank without any attention.

SEMAPHORE LONG-TIME BURNING OIL.

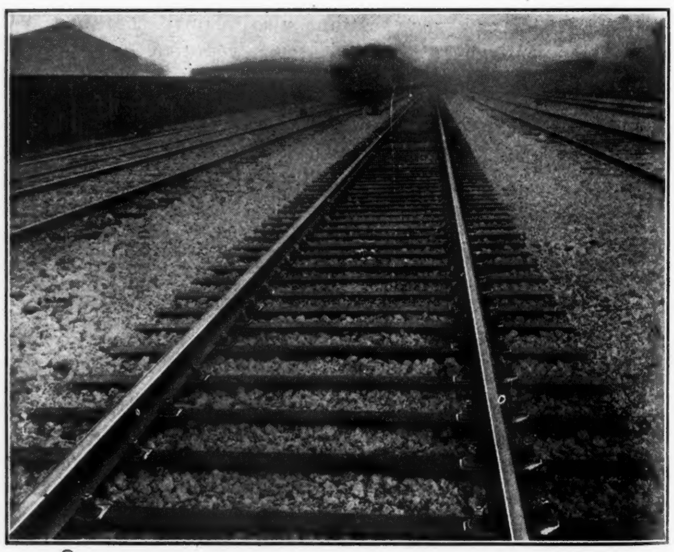
The problem of producing a signal oil that will withstand low temperatures is bad enough. The Moloney Oil & Manufacturing Co., of Scranton, Pa., having solved that problem, has tackled one that is even more difficult. The service record of its product during the hard winter of 1911-12 showed that the company's semaphore long-time burning oil will not freeze. But the company recently completed some exhaustive experiments to produce a signal oil that cannot freeze. Service records show that the recent output of signal oil will burn through periods of lower temperatures than 25 deg. below zero. It withstood as low as 30 deg. below zero in 1912, in actual service.

The semaphore long-time burning oil is scientifically refined, contains no sulphur—which causes crustation on lamp wicks—has a fire test of 150 deg., and is designed to burn for from 150 to 170 hours without attention.

It is not generally understood that there is a difference between the requirements for one-day burners in signal lamps and for long-time burners. There is, however; and the semaphore long-time burning oil is designed to satisfy the more rigorous demands of the signal system which requires continuous day and night illumination of the signals with inspection by the maintenance force only at intervals of from one to three days. As the result of three years' trial under service conditions and exhaustive laboratory tests, the company is now offering to submit samples of its signal grade—the semaphore long-time burning oil—for test purposes.

STEEL TIE INSULATION.

One of the objections most frequently urged against steel ties is the difficulty of insulation, especially with reference to signal circuits. To give satisfactory service in track,



Steel Tie Track on Pittsburgh & Lake Erie Insulated with Fibre Shims.

they must not only provide the required insulation when installed, but must maintain it under the wear and load of the rail and other track fastenings regardless of whether the insulation is riveted or bolted between the rail and the tie. The Pittsburgh & Lake Erie has an installation of

3,000 Carnegie I beam steel ties in the main westbound freight track at McKee's Rocks, Pa., which was put in during the summer of 1907. This track, which is shown in the accompanying photograph, is insulated with 6,000 American Vulcanized Fibre Co.'s fibre shims. This track carries an average daily traffic of 16 heavy freight trains and about 10 trains of miscellaneous freight and about 25 heavy engine movements. It is said that in spite of this traffic not a single signal failure has occurred because of defective insulation since this fibre has been in service.

NEW HEAVY TRACK SCALE.

The Southern Railway has recently installed a new track scale at Granite Quarry, near Salisbury, S. C., which is of an improved type and especially heavy construction. Several features of note are included in the design, which was built in accordance with specifications of the engineering department.

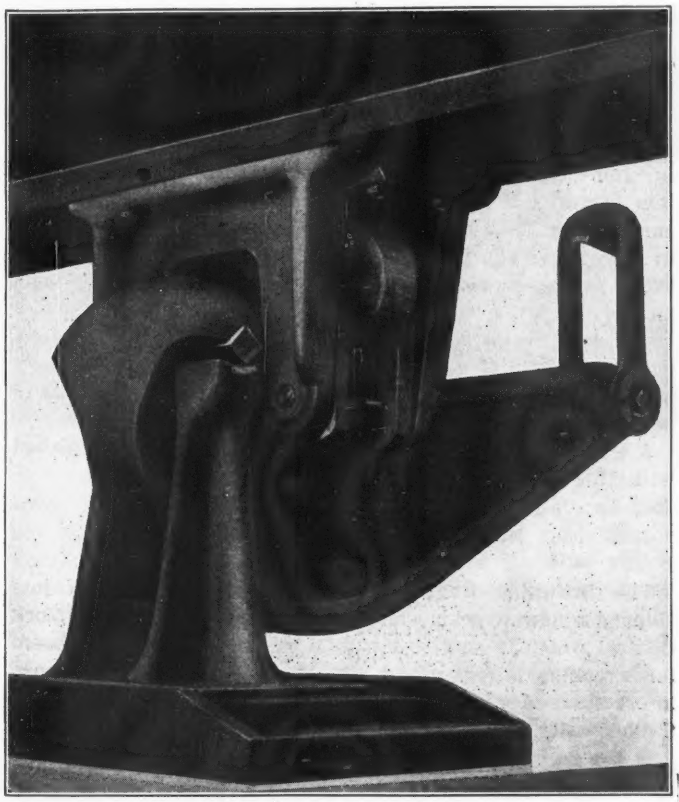
This scale has a Strait suspended platform and is of the four-section extra heavy railroad pattern. It is 54 ft. long and has a capacity of 150 tons, although provision is made for an additional load of 150 tons for impact, so that its strength is sufficient to carry and to weigh a dead load of 300 tons.

The length of knife and pivot edge bearings are also proportionately increased throughout, and are backed or supported by the metal being carried out as shown in the half-tone cut. The excess strength and increased proportions are for the purpose of insuring the utmost accuracy as well as the greatest durability and freedom from breakage under the hardest service.

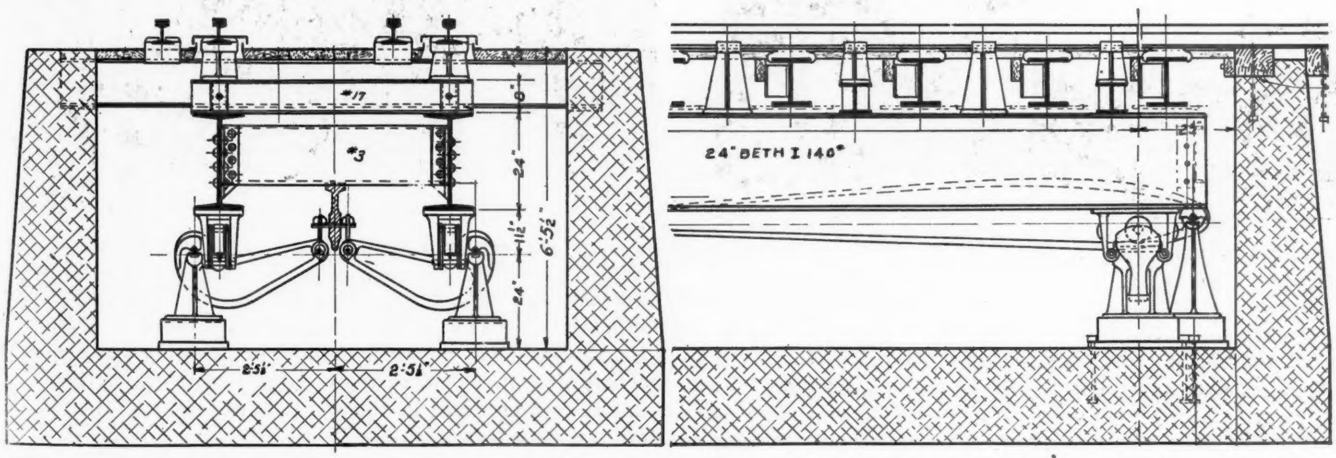
The scale itself has no action other than that of weighing, not being set in motion by the vibration of the platform. The platform is suspended from "bearing feet" resting on the knife edges, permitting it to vibrate independently. All pivots and knife edges are thereby relieved of unnecessary wear. No check rods are used; the platform being in no way connected with the frame work or any stationary part, is always free, so that inaccurate weights from interference are prevented. The bearing feet are so designed that they cannot shift on the knife edges which prevents change in balance, the cause of much inaccuracy.

The scale is erected upon "wedge adjustable" foundation plates grouted in the concrete, enabling any lever to be easily brought up to proper level simply by the use of a wrench, should there be any change or settling of the foundation. Bronze adjusting bolts are used so that rust will not prevent operating. No underframing of structural steel is employed, thereby reducing the expense of painting, which is necessary to prevent rust when this material is used in such locations.

The superstructure is what is known as the stationary deck or platform, being supported by crosswise steel beams laid in recesses in the coping wall. The "dead" track rails are carried by cast iron bearing blocks resting directly on the crosswise supporting "H" section Bethlehem beams, these blocks being of suitable shape to fit over the beams and to receive the rails. The live track is carried by cast iron chairs projecting through openings in the stationary deck. These openings are protected by dirt shields. Each alternate chair rests on the lengthwise main stringers and each other alternate and shorter chair is supported by crosswise "H" section Bethlehem beams riveted to the main stringers.



Main Lever and Suspension Bearing Supporting I Beams of Scale Track.



Cross and Longitudinal Sections Showing All-Steel Construction, with Overhang and Wedge Adjusting Foundation Plates.

Filler blocks are provided in the crosswise "H" section beams under the chairs, giving the same effect as if solid. The main stringers are 24 in., 140 lb. Bethlehem girders, having a flange 13 in. wide, which, in connection with the fillers and lateral bracing, makes an exceedingly stable and

substantial construction. Neither the live nor dead tracks or any part pertaining to the operation and maintenance of the scale is connected to or depends on timbers or any perishable material.

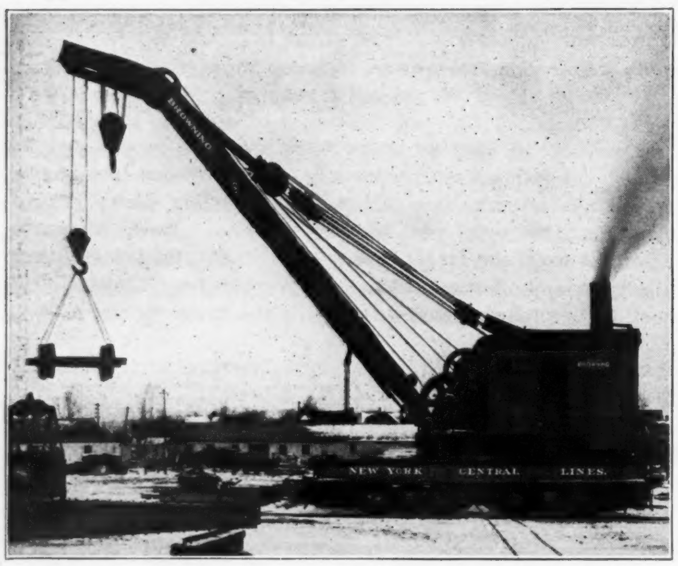
The scale is built with overhang construction or what is sometimes called bridge-ends. The approach tracks are carried over the scale two ft. at each end, leaving a 50 ft. live or weighing track. The load, therefore, is delivered directly over the center of the main levers of the first section, producing no tilting or cantilever effect.

The levers and all active parts are carried up well above any possible interference from accumulating ice or debris. In connection with the fact that no check rods are used, this prevents the scale from freezing up, a cause of much annoyance in cold countries. There is ample room for a man to pass above the main levers in going through the pit, and every part is convenient to inspect. The design of the scale allows any lever to be easily removed without taking out a single bolt or knocking out any pivot. This may be done without even losing the use of the track. The pit has a level floor, making it very convenient to do such work and to keep the pit clean.

A type registering (printing) beam was, of course, furnished with this scale.

NEW YORK CENTRAL CRANE.

The Browning Engineering Co., Cleveland, O., has just shipped a new wrecking and erecting crane to the New York Central which is equipped with a standard goose neck boom for wrecking purposes and also with a 60 ft. boom for use in erection. A special feature of the design of this crane was the necessity for clearing the third rail on the electrified lines



New Wrecking Crane for New York Central Lines.

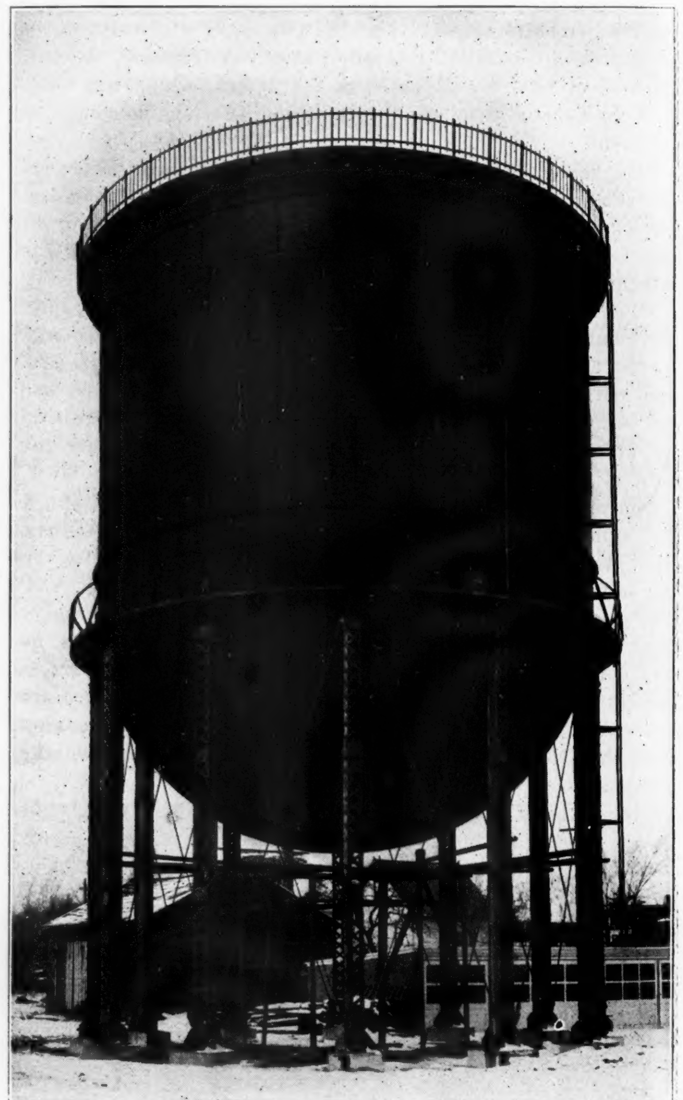
of the New York Central. The car body is 25 ft. 8 in. long and made of 18 in. girder beams. The wheel base is 16 ft. ½ in., the trucks conforming to the M. C. B. standard.

The rotating superstructure is carried on a roller 7 ft. 10 in. in diameter, and the crane is housed in with sheet iron. The goose neck boom is 40 ft. long, with an extension of 10 ft. at the bottom, by means of which it may be used as a 50 ft. boom. There is a main hoist block having a capacity of 45 tons and an auxiliary block of 15 tons capacity. The weight of the crane in working order is about 190,000 lb. The speed of the main hoist block on the six-part line is 20 to 25 ft. a min., and the auxiliary hoist on the two-part line is about 60 ft. per min. The crane is self-propelled through a gear on the inside axle of each truck and has a travel speed on level grade of about 500 ft. a minute.

A LARGE RAILWAY STYLE WATER TOWER.

On account of an error in the make-up of yesterday morning's Daily, by which the illustration of the steel tank at Lakewood, O., was omitted from the description, we are repeating this description below to accompany the cut, as shown herewith.

This tank is believed to be the largest steel tank on a short steel tower ever built and is of a style commonly used by railways. It has a capacity of 560,000 gal. and height to bottom of tank of about 18 ft. The total height is 70 ft. and the diameter 46 ft. The bottom of the tank is constructed of compound curve, the largest radius of



Large Steel Water Tank at Lakewood, O.

curvature being about 24 ft. The twelve columns are each supported by a pier 10 ft. square at base and 6 ft, high. No roof is used on this tank. The two balconies are for ornamentation and also for convenience in inspection. The initial cost of tanks of the size illustrated approximates five cents per gallon.

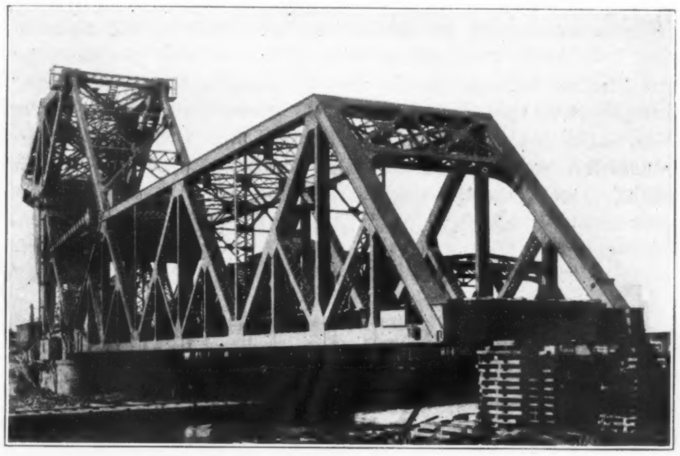
This structure illustrates the tendency of engineers to abandon the steel stand pipe having a flat bottom resting on a masonry pier. A large portion of the cost of flat-bottom stand pipes is included in the extra masonry required to support them. The water in the lower portion is usually not available for service and failures due to rusting out of metal sometimes occur. The structure shown was designed and built by the Des Moines Bridge & Iron Co., Pittsburgh, Pa.

STRAUSS BASCULE BRIDGE AT SOUTH CHICAGO.

The erection of the Strauss bascule bridge for the Baltimore & Ohio over the Calumet river at South Chicago, which is the longest and heaviest single leaf bascule span in the world, has just been completed. This bridge has a 50 ft. tower span and a 235 ft. single leaf double track movable span. The substructure includes six cylindrical concrete piers about 80 ft. high and 12 ft. in diameter. In the construction of these piers an unusual method of internal bracing was used in the open wells which were sunk to rock in which to build the cylinders. Cofferdams of 3 in. by 12 in. tongue and groove sheet piling were used for about the first 18 ft. of the excavation, which was through quicksand. At this depth a stiff blue clay was reached, which extended down to rock. An open well was driven in the bottom of each cofferdam and was lined with horizontal sections of No. 20 corrugated iron. Commercial sheets about 9 ft. long were bent to a 6 ft. radius, each sheet having riveted to its ends 2 in. by 2 in. angles, with holes in the outstanding legs to allow the connection of abutting sections in the same course to form a solid ring. The courses were placed from the top down, each course overlapping the upper one by a single corrugation. It was found that this construction provided tight joints and only at one point was there any tendency for the sheeting to yield to the external pressure. After the completion of these wells, they were filled with 1:3:5 concrete.

The structural steel in the superstructure of this bridge weighs 1,300 tons and the counterweight 2,000 tons. The bridge is designed for a loading of Cooper's E-50, the trusses differing only slightly from a stationary span of similar dimensions. The trusses bear directly on the river piers and the floor system and top and bottom laterals are the same as those ordinarily used in fixed spans. This bridge, in common with all other heel trunnion bridges of this type, has constant and vertical reactions upon the supporting piers, allowing an economical design of these piers. This was the first bridge of the Strauss design which has been built without side bracing for the towers. It was necessary to omit the bracing in this design on account of the close proximity of the tracks of another road, but after a careful analysis of the steel work was designed according to Greiner's bascule specifications.

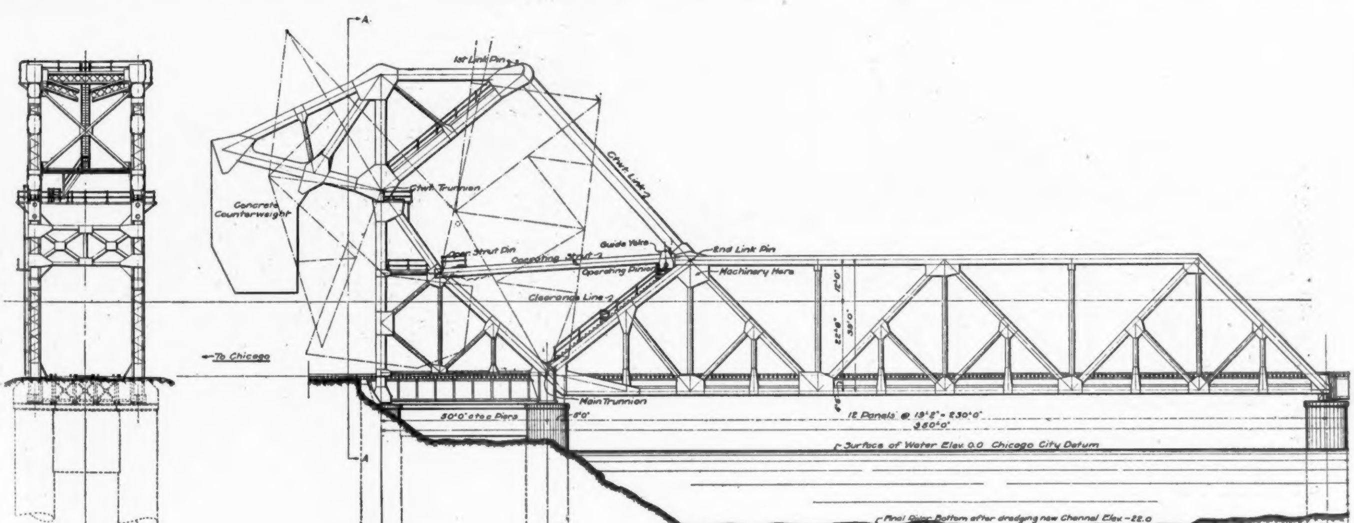
The bridge is designed to move from the closed to the fully opened position in 1.25 min. The operating machinery is located over the end portal at the trunnion end of the movable span. In some of the later designs by this com-



Bridge Shortly After Being Lowered.

pany, the machinery is located on the tower, a feature which has some advantages. Electric power will be used for the operation of the bridge, and an auxiliary gasoline engine plant has been installed, which is capable of operating the bridge in case of any failure of the electric power. The operator's tower is located alongside the bridge, but is built as an independent structure and is so designed that it can serve both the present bridge and a future double track bridge, which has already been contracted for, to be built alongside the present one.

The movable span was erected in the open position, which has been found advantageous, and was first lowered on Saturday, February 15. At this time a complete set of tests was made on the operation of the bridge. The tests included observations on the time required for operating the leaf, the power consumption in various positions, and all other features that will have a bearing on its efficient operation.



Elevation and Section of Strauss Bascule at South Chicago.

stresses in the tower, it was found that this bracing is not in any way essential, and it is expected that in future these structures will in general be built without it. The stability of the tower is increased as the size and weight of the bridge increases, so that it will not be difficult to apply such towers without side bracing to even the largest bridges. The

When the structure was first lowered, it was found to be only ⅛ in. out of alinement. The operating time of 1.25 min. was made exactly at the first trial. The bridge is not to be placed in operation immediately, as the swing span of the Lake Shore & Michigan Southern, which is closely adjacent to the new Baltimore & Ohio bridge, swings over the

site of the rest pier of the new trunnion bridge so that this pier cannot be completed up to its full height. The Lake Shore & Michigan Southern is at present replacing its span, however, and when that company's new bridge is complete, the rest pier will be finished and the B. & O. bridge put into operation. In the meantime, the movable leaf will be allowed to stand in the fully opened position.

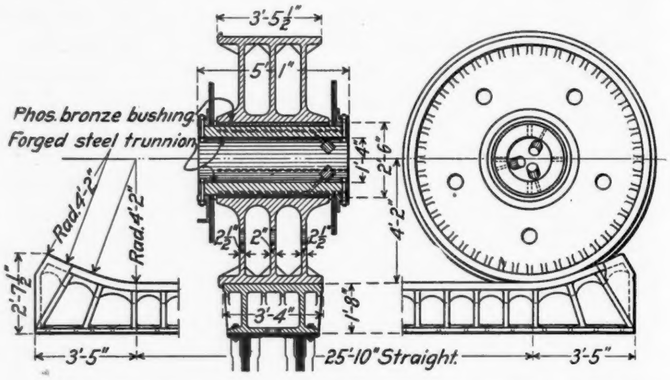
The substructure for this bridge was built by the Foundation Co., New York. The superstructure was designed by the Strauss Bascule Bridge Co., Chicago, and was fabricated and erected by the Pennsylvania Steel Co., Steelton, Pa. The entire work was under the direction of J. E. Greiner, consulting bridge engineer; F. L. Stuart, chief engineer, and W. S. Bouton, bridge engineer, Baltimore & Ohio.

RALL BASCULE BRIDGE AT PORTLAND, ORE.

The two leaf Rall bascule span of the Broadway bridge over the Willamette river, Portland, Ore., is the largest rolling trunnion bridge ever built. The span center to center of piers is 278 ft., and the clear distance at the top of the raised leaves when fully opened is 250 ft. The roadway is 46 ft. 6 in. wide between guards and provision is made for two street car tracks and two wagon ways. On the outside of the main trusses, which are 50 ft. on centers, 9 ft. sidewalks are provided, making the width of the bridge 70 ft. over all.

A special feature of this bridge was that the specifications required the trusses of the bascule span to be in line with the trusses of the approach spans. This necessitated special recesses in the counterweight boxes and their truss supports to enable them to pass between the trusses of the approach spans and also developed many interesting problems in the design of the bracing and other details for adjustment, expansion, etc.

The rolling load of each leaf, including the counterweight, is approximately 2,000 tons, each roller, therefore, carrying a load of about 1,000 tons. The rollers are each 8 ft. 4 in. in diameter and 40 in. long. In order to properly distribute the rolling load to the carrying girder a steel track casting 20 in. high is provided, which transfers the load directly to the web section of the supporting girder without depending on rivets for the distribution. The rollers and the bearing castings are of nickel chrome steel. The distributing castings, as well as the rollers, are without cogs or teeth, so



Main Trunnion, Roller and Supporting Track of Rall Bascule Bridge.

that the operation of the bridge is smooth and practically noiseless. When the bascule span is closed, the heel of the river arm bears on a lower support directly over the pier. This support carries all the live load of the bascule span and, if desired, may be adjusted vertically to carry a portion or all of the rolling load.

Ralph Modjeski of Chicago is chief engineer in charge of the general design and construction for the city of Portland. The bascule span was designed by the Strobel Steel Construction Co., Chicago, which controls the Rall patents. The Pennsylvania Steel Co., Steelton, Pa., is the contractor for the superstructure of the entire bridge, including the machinery and electrical equipment for the bascule span. The bridge is nearly completed, and the bascule span has been successfully operated.

Rall Rolling Bascule Span Over Willamette River, Portland, Ore.